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INFORMATION BASIC TO FARM ADJUSTMENTS IN THE HIGH PLAINS COTTON AREA OF TEXAS

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Division of Farm and Ranch Economics

in Cooperation with

Bureau of Agricultural Economics
U. S. Department of Agriculture

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

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This bulletin deals with production and production requirements, the manner in which they are affected by changes in the combination of enterprises and production practices, and in turn the probable effect of these changes on farm earnings in the High Plains Cotton Area.

Farmers have been quick to take advantage of improvements in machinery and power. Within a period of 15 years they have shifted almost completely from one-row horse-drawn machinery to two- and four-row motorized equipment. Single-row horse-drawn implements were superseded by two-row horse-drawn machinery which in turn was replaced by multi-row tractor equipment.

The rapid shift to larger power and equipment has greatly increased the efficiency of labor. Under usual conditions, pre-harvest labor amounting to 10.45 hours was required per acre of cotton with single-row horse machinery and 6.65 hours with two-row horse-drawn implements. With two- and four-row tractor-drawn equipment the requirements for pre-harvest labor per acre of cotton were reduced to 5.5 and 4.3 hours, respectively. Comparable savings of labor resulted for other crops.

Recently improved combines along with the development of varieties of grain sorghums suitable for combining have enabled farmers to complete the mechanization of sorghum grain production. A total of 1.8 hours of labor was required to harvest sorghum grains by combining compared to an average of 4.45 hours when sorghums were hand-headed.

A stripper type cotton harvester has been developed by the Texas Agricultural Experiment Station. A limited number of these machines were manufactured for distribution in 1943 and more will be available in 1944. Two men using a two-row machine of this type will harvest as much cotton per day as 14 to 16 men will harvest by snapping.

Labor savings associated with the shift to a high level of mechanization has greatly increased the crop acreage that can be operated per man. The general trend has been toward the operation of larger units. Assuming the maximum acreage of cotton that can be readily planted and cultivated, one man can operate, with the help of extra labor for hoeing and harvesting, approximately 100 acres of cropland with one set of single-row horse-drawn machinery or 180 acres with two-row horse-drawn implements. This acreage can be increased to 250 by the use of two-row tractor equipment and to 450 acres with four-row tractor equipment.

During the period of the study, cotton production was the most profitable enterprise in the area. The limitations placed on cotton production by the establishment of marketing quotas made it necessary for a large proportion of operators to modify their system of farming. These adjustments entailed a reduction in cotton acreage and increased production of grain and forage or pasture crops.

The best plan within the limitations of the Agricultural Adjustment program was to grow the maximum acreage of cotton allotted and plant sorghum grain for the remainder of the soil depleting allotment. Forage and grazing crops were grown as soil conserving crops. It was more profitable to market feed through livestock than on the cash market with prices which prevailed during 1942. A combination of hogs and dairy cattle or hogs, dairy cattle and chickens gave greater returns for feed crops than did beef calves. Substituting poultry for a part of the hog enterprise had little influence on income.

During wartime, price relationships and the supply of farm labor are basic considerations in adjusting farm organizations to war needs. Farmers can minimize the effects of a reduced labor supply by harvesting cotton and grain sorghums mechanically. With mechanical harvesting of these crops, price relationships largely determine the direction of adjustments.

CONTENTS

INFORMATION BASIC TO FARM ADJUSTMENTS IN THE HIGH PLAINS COTTON AREA OF TEXAS

By

A. C. Magee,[1] C. A. Bonnen[2] and B. H. Thibodeaux[3]

This bulletin reports some of the results of a farm management study in the High Plains Cotton Area of Texas the location of which is shown in Figure 1. Previously an extensive cattle ranching country, the area has shifted almost completely to crop farming during the past 25 to 30 years. In the shift from ranching to farming many problems of adaptation and adjustment have been encountered. The turbulent economic conditions of the past decade have accentuated some of these problems and added others. For example the area was settled pretty largely during the 1920's when cotton prices were relatively high as compared with livestock and feed prices. This resulted in a high degree of specialization in cotton production and in the valuation of land at a much higher level than could be sustained with subsequent prices of cotton and other commodities produced on the land. As a consequence many adjustments in the organization and operation of farms were needed and are being made. This study the organization and operation of the cooperating farms as related to farm was made for the purpose of facilitating these adjustments. Some of the results of this study were published in Bulletin No. 568 "An Economic Study of Farm Organization and Operation in the High Plains Cotton Area of Texas." That publication dealt primarily with the differences in earnings. This bulletin deals with production and production requirements, the manner in which they are affected by changes in the combination of enterprises and production practices, and in turn, the probable effect of these changes on farm earnings.

The data upon which this study is based were obtained through cooperation with representative farmers who were well distributed over the five main counties of the area. An average of 137 farmers kept complete records of their farm business and supplied information pertaining to production and production practices for a period of five years, 1931-1935. Seventy farm records were summarized for 1936 and a smaller number for 1937. During 1936 the Soil Conservation Service prepared soil maps of the farms of all the 1935 cooperators. This was followed in 1937 by a survey of soil and moisture conservation practices. A survey was made in 1938 and again in 1940 of the adjustments farmers were making in the use of motorized equipment. More recently and largely through the assistance of the Superintendent of Substation No. 8 at Lubbock the data were adjusted to changes resulting from the introduction of combining as the common method of harvesting grain sorghum.

For a more complete description of the procedure followed in making the study and for a short history of the agricultural developments in the area, the reader is referred to Bulletin No. 568.

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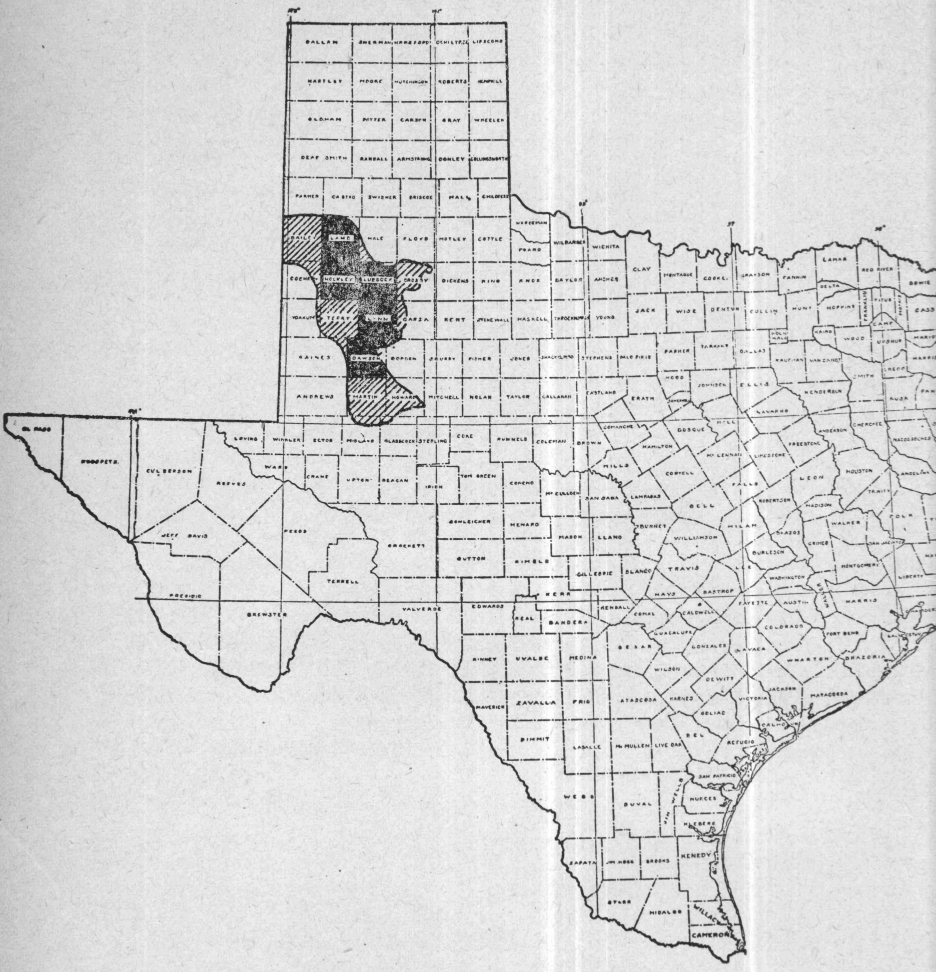

Figure 1. The location of the High Plains Cotton Area is indicated by the shaded area. The black portion shows the counties in which farm records were obtained.

SOILS AND TOPOGRAPHY

The High Plains Cotton Area may be described as a tilted plain which slopes to the south and east at the rate of 6 to 7 feet per mile. The general flatness of the area is broken only by an occasional canyon or draw and by small playa lake basins into which most of the drainage water of the area collects. These basins are usually dry except during and after rainy seasons.

The soils of the area vary in texture from fine sands to heavy clays and clay loams. For purposes of this study they have been grouped into three classes: (1) fine sandy loams, (2) loamy fine sand, and (3) loams, clay loams, and clays. The fine sandy loams are the dominant soils of the area.

The chief difference between the fine sandy loams and the loamy fine sands is found in the depth and texture of the surface soil. The surface soils of the fine sandy loams are reddish brown in color and range from 8 to 20 inches in depth. The subsoil is sandy clay. The surface soil of the loamy fine sand is lighter in both color and texture and ranges in depth from 20 inches to several feet. The subsoil is also sandy clay. Both of these groups absorb water rapidly and the subsoils have the capacity for storing large amounts of moisture. After crops become well established on these soils they can withstand prolonged drought. While both groups are subject to wind erosion the loamy fine sands are more susceptible to blowing and consequently are much more difficult to manage than are the heavier textured fine sandy loams.

The loams, clay loams and clays are locally referred to as "tight land." These heavy soils do not absorb moisture as rapidly as do the sandy soils. Crops growing on "tight land" are the first to suffer from drought. On the other hand, during years of favorable moisture conditions, production on these soils compares favorably with production on the fine sandy loams. The heavy soils tend to be coherent and if not finely pulverized are quite resistant to blowing.

CLIMATE

The climate of the High Plains Cotton Area is characteristically subhumid. The average rainfall of between 18 and 20 inches approaches the lower limit for successful dryland farming. A high percentage of the rainfall comes in the form of local showers. These showers are frequently of the torrential type. Hailstorms occur occasionally but are seldom destructive over a large area.

The average annual rainfall and the annual precipitation during each of the five years of the study at six weather stations in the area are given in Table 1. Extreme irregularity occurs in the annual rainfall. For example, 33 inches of rain fell at Lamesa in 1932 as compared with 12 inches in 1933, 9 inches in 1934 and an average annual precipitation for a 26-year period of 18 inches.

Table 1. Precipitation at Six U. S. Weather Bureau Stations in the High Plains Cotton Area

Station	County	Number of years precipitation record	Average annual precipitation (inches)	Annual precipitation (inches)				
				1931	1932	1933	1934	1935
Lubbock	Lubbock	26	19.00	19.36	24.16	10.31	9.72	17.29
Lamesa	Dawson	26	18.16[1]	19.59	33.36	12.28	8.91	27.62
Littlefield	Lamb	10	17.83	22.83	19.66	13.57	12.05	14.36
Muleshoe	Bailey	16	17.99	21.05	17.33	13.55	15.21	14.90
Tahoka	Lynn	7	18.98[2]	15.33	25.29	15.56	——	18.75
Big Spring	Howard	38	18.70[3]	22.33	29.22	11.33	14.61	19.51

[1]Information for 1921 and 1923 incomplete. These years not included in average.
[2]Information for 1934 and 1937 incomplete. These years not included in average.
[3]Information for 1936 and 1937 incomplete. These years not included in average.

That the amount of rainfall received during a particular year may vary widely at different points is revealed in Table 1. In 1932 the precipitation at Lamesa was almost twice the amount recorded at Muleshoe but in 1934 the situation was reversed. In 1935 Lamesa again recorded almost twice the amount of rainfall as did Muleshoe.

Owing to the fact that a large part of the precipitation is in the form of local showers extreme variations in rainfall may occur between communities within the same county and result in abundant crops in one community and low yields in an adjoining community. Rainfall is also somewhat lighter and more varied in the western and southern parts of the area.

On the average, more than four-fifths of the total annual precipitation falls during the growing season from April to October inclusive and approximately half during June, July and August when row crops are in greatest need of moisture. The rainfall may be so poorly distributed

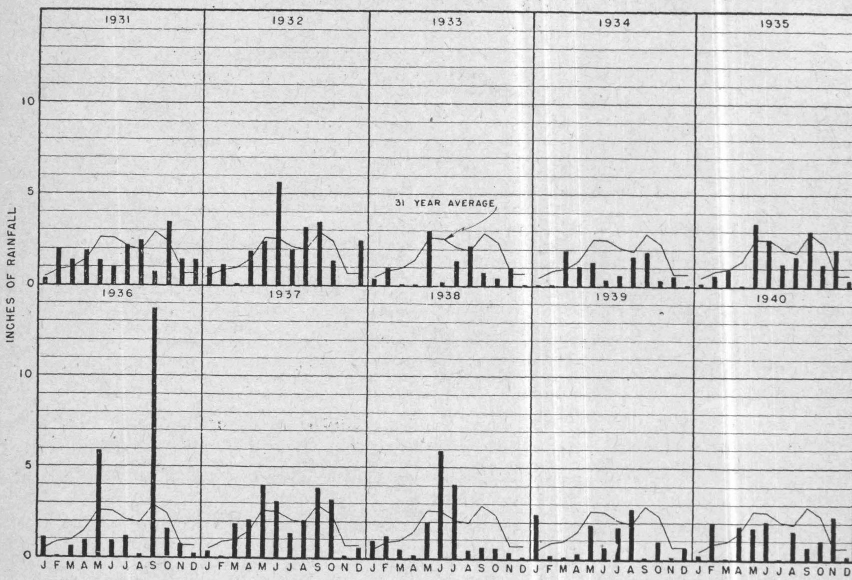

Figure 2. A comparison of monthly and normal precipitation at Lubbock in the High Plains Cotton Area. 1931-1940.

within any one year, as to affect adversely the growth of crops. (See Figure 2). A short drought during the normal fruiting period of a crop may result in a large reduction in yields.

All of the above variations are particularly significant since the average precipitation is so near the minimum for successful crop production.

The effectiveness of the rainfall is somewhat reduced by a high rate of evaporation which averaged 63 inches annually from an open surface tank at Lubbock from 1911-1941. This is more than three times the average annual rainfall and compares with 44 inches at Angleton in the Coastal Prairie and with 58 inches at Temple in the Black Prairie. This high rate of evaporation is chiefly significant from the standpoint of its effect on planting opportunities. Moisture in the top soil is removed rapidly after a rain, thereby reducing the number of planting opportunities and the length of the optimum planting period for all crops.

The growing season or frost-free period averages 210 days at Lubbock. The growing season at points of the same latitude in the Black Prairie in the eastern part of the state averages three to four weeks longer owing largely to differences in altitude of 2,000 to 3,000 feet. These high altitudes ranging from 2,500 feet in the southern part of the area to 3,700 feet in the northwestern part also result in relatively cool nights throughout the growing season.

Over a period of 31 years the frost-free period has varied from 165 days in 1917 to 246 days in 1919, a range of 81 days. In other than these two years the frost-free period was never less than 180 days nor more than 240 days. In 22 of the 31 years it was more than 200 days in length. (See Figure 3). The average date of the last frost in the spring

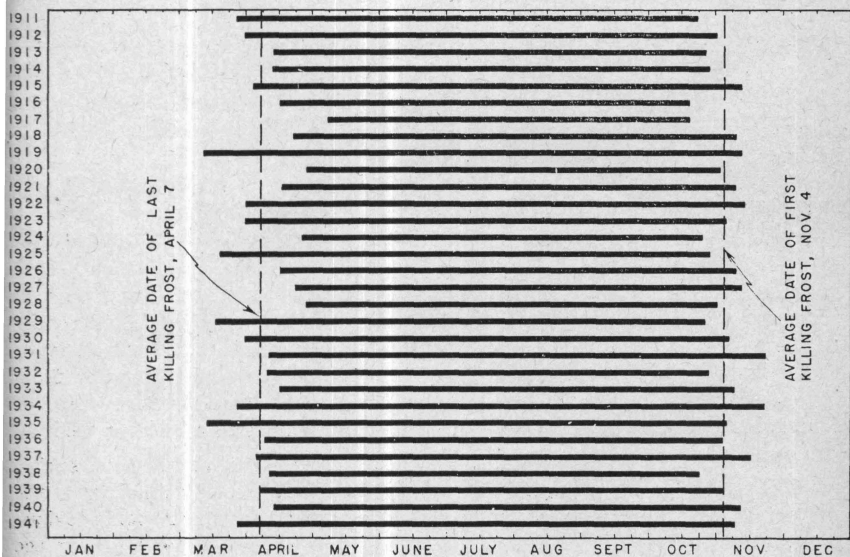

Figure 3. A comparison of the length of the frost-free period during each of 31 years with the average at Lubbock.

is April 7. It ranged, however, from March 11 to May 7. The date of the last frost occurred 11 times during March, 19 times during April, and once during May.

The date of the first frost in the fall is not so variable as is the date of the last frost in the spring. Every year during the past 31 it has fallen between October 19 and November 22, a range of only 35 days.

The effective length of the growing season is frequently shortened in this area by other climatic factors such as lack of moisture, wind damage, hail or the torrentiatl type of rainstorm which sometimes result in late planting or replanting. Long periods of lower than average temperatures or above normal rainfall accompanied by low night temperatures, during the late summer and fall, are conditions that retard plant development and have the effect of shortening the growing season.

SOIL AND MOISTURE CONSERVATION AND FERTILITY MAINTENANCE

Soil and moisture conservation and fertility maintenance are closely related problems the solutions of which are dependent upon many of the same practices. The close relationship between soil and moisture conservation is indicated by the fact that wind erosion control is more difficult when soils are dry than when soil moisture is plentiful. This is particularly true when the ground has little or no vegetative cover.

Since wind erosion causes the loss of fertile top soil and also loss of stand of young crops, its control is important both from the long-time standpoint of fertility maintenance and from the standpoint of year to year crop production.

Fertility losses usually take place slowly because of the fact that losses incurred in one place may be at least partially replaced by deposits from other places. Some shifting of top soil takes place nearly every year. Prevention and control of soil blowing consists of keeping wind resistant materials on the surface. These may be crops, crop residues or clods.

The first objective of moisture conservation is to prevent run-off and to get as much of the rainfall absorbed into the soil as possible. The second objective is to retard evaporation losses and to hold soil moisture available for plant use.

Both the soils and the nature of the rainfall facilitate moisture conservation. The sandy soils absorb water readily and while torrential showers are frequent they are usually of short duration. A majority of the rains are of less than one inch. According to weather records from the Agricultural Experiment Substation at Lubbock, there is an average of four rains per year which amount to one inch or more in a 24-hour period.

Wind erosion is most likely to occur during the winter and spring months. At this time, high winds are common and soils do not have the protection afforded by growing crops. Failure to control erosion previous to planting often results in a loose, finely pulverized deposit of surface soil which may later result in damage to young plants. Very little wind damage occurs after crops become well established. Any field operation that pulverizes the surface soil to a powder-like consistency should be avoided as it leaves the soil in condition to blow easily. For this reason, such implements as the disk, spike tooth harrow, and one-way plow are not used extensively in the area. Cultural practices that leave the surface slightly irregular check both run-off and the movement of wind-blown soil particles and are preferred to those that leave the surface very smooth.

When moisture conditions are favorable, it is usually possible to control wind erosion before planting by listing or by some other common field operation. In case soils are too dry for listing, chiseling may be resorted to as a temporary check to erosion. In chiseling, a sharp, narrow point is substituted for the usual shear on the lister beam.

Listing is the common method of preparing the seed bed and is preferred to flat-breaking, because it provides furrows in which moisture may collect to check run-off effectively, especially when the rows are run on the contour or cross-wise to the prevailing slope. Listing also results in less evaporation than does flat-breaking. Deep listing (5 to 8 inches) is preferred to shallow listing for both moisture conservation and erosion control. The deeper furrows hold more water and the clay and sandy clay materials brought to the surface by deep listing increases resistance to wind erosion.

Clean cultivation of crops prevents moisture losses through weed growth. Experience has shown that less rainfall is required for successful planting when weed growth has been controlled previous to planting. This is especially important during years when moisture is limited at planting time. Lister beds are commonly cleaned of weeds by knifing, which also leaves a lumpy surface and exposes little additional surface to evaporation.

Young crops are frequently damaged by wind-blown soil particles. This may occur despite the presence of ample soil moisture. Failure to control wind damage may necessitate a great deal of replanting or may prevent the establishment of the desired acreage of cotton within the optimum planting period for cotton. Cultivating, center furrowing, plowing furrows cross-wise with the row, or any field operation that breaks and roughs up the surface is effective, temporarily at least, in checking erosion damage to young crops. These practices are most effective when done before the surface becomes thoroughly dry.

Terracing and contour farming are effective means of preventing loss of moisture through run-off. With the level type terraces that are built in the area, it is usually possible to hold all the rainfall. Although water erosion is not important for the area as a whole, terracing and contouring are usually effective controls for any water erosion problem which may occur. Because of the gently sloping surface, farmers consider contouring almost as effective in controlling run-off as is terracing. This is particularly true on the fine sandy loam and loamy fine sand soils which absorb water rapidly. Running rows with the contour also facilitates the control of wind erosion. The variation in direction of contour rows is sufficient to check, or partly check, the wind sweep.

Although terracing and contouring are both in common use in the area, contouring is much more extensively practiced at present than is terracing. The following points should be kept in mind when considering the relative advantages of terracing or contouring:

1. Terracing, as a rule, will permit less water to escape than contouring. This is particularly true during the late summer after planter ridges have been worked down nearly flat.
2. The relative cost of terracing is much greater than contouring.
3. Terraces require considerable up-keep to maintain their effectiveness. Contouring requires very little up-keep.
4. Special equipment is required to build and maintain terraces that ordinarily must be purchased or hired.
5. Contoured fields are usually more conveniently farmed with three- and four-row equipment than terraced fields. Terraces sometimes interfere with the use of large machinery. Broad, wide-based terraces are needed when three- and four-row equipment is used.
6. Contour rows can easily be adjusted or changed with very little labor or expense.

There is a tendency for organic matter to be depleted more rapidly than it is added to the soil. This is particularly true for land that is cropped to cotton a large portion of the time, as the crop residue is not sufficient to maintain the organic content of the soils at a high level. The stalks that remain after grain sorghums are headed return a much larger amount of vegetative material to the land. As the natural supply of organic matter in the soil is depleted, the surface crusts more readily, is less absorptive of water, and is generally less conserving of moisture. Depletion of humus is accompanied by increased difficulty in establishing crops, due to soil movement.

The quickest method of adding humus is to plow under a heavy growth of green vegetation. This material decomposes readily, makes the soil mellow and easily pulverized, reduces crusting, and increases the moisture-holding capacity of the soil. Under conditions of low soil moisture, however, the presence of large amounts of recently decomposed organic matter leaves the soil light and powdery, a condition conducive to wind erosion. It is most satisfactory to work organic matter into the soil slowly leaving stalks and coarse materials to protect the surface and to check the movement of soil particles. This can be accomplished by frequent use of crops such as grain sorghums that furnish a relatively large amount of slow-decaying crop residue.

Fallowing is not commonly practiced in the area because of the wind erosion hazard which results when sandy soils are left without vegetative cover. Instead, farmers endeavor to maintain some vegetative cover during the winter. Grain sorghums are sometimes planted extremely late for the sole purpose of furnishing soil protection. The experience of farmers indicates that stalk fields should not be heavily pastured. The grazing and tramping of livestock reduces the protection furnished by crop residue and loosens the top soil so that it blows readily.

A wild, shallow-rooted grass, *Eragrastis Mexicana,* commonly called stink grass, has been spreading over the High Plains Cotton Area during recent years and has some possibilities for erosion control. Early crops of the grass are usually destroyed by cultivation, but a stand often comes up and matures after crops are "laid by" and furnishes effective erosion control previous to listing.

Generally speaking, the soils of the area are fertile and will produce abundant yields of the crops grown when favorable climatic conditions prevail. At present, moisture rather than soil fertility is the factor that limits crop production and maintenance of soil fertility is not now recognized as a serious problem by those farming in the area.

Various factors tend to reduce the losses or depletion of soil nutrients to a comparatively low point. Low average rainfall, a surface soil that absorbs moisture readily, and a level topography tend to reduce water erosion and soil fertility losses to a minimum. Because of the character of the rainfall, there is little loss of fertility by leaching. The crops grown make a light vegetative growth and require comparatively small amounts of soil nutrients to produce a crop. Good yields of lint are obtained on a relatively small cotton plant and most of the grain sorghums are of the dwarf type. During years of crop failure or of low yields, very little fertility is removed by crop production. Subsequent plant behavior indicates that the forces which make plant food available continue to function during years too dry for crop production.

The natural soil fertility has not been depleted to the extent that commercial fertilizers can profitably be used. On the average, moisture is insufficient for plants to use effectively the additional nutrients that are available when commercial fertilizer is added. The application of fertilizer usually causes a more rapid and succulent plant growth. Since plant growth requires moisture, an increase in the rate of growth causes a more rapid withdrawal of moisture from the soil and early depletion during periods of limited supply. This condition is more apt to result in serious damage to the growing crop than if the available moisture is withdrawn more slowly and over a longer period of time.

Farmers in the area have very little barnyard manure to use as fertilizer. Livestock are usually kept in pastures or corrals, making the collection of manure impracticable. A large part of the manure that accumulates in small corrals is dissipated by the wind before it can be used. Available manure has generally been used on small irrigated gardens, and gives good results when accompanied with plenty of water. Plants are injured by burning when large amounts of manure are applied unless an ample supply of soil moisture is available.

It is difficult to maintain a definite crop rotation in the area because crop plantings are so often a matter of opportunity. The principal crops, cotton and sorghums, are frequently alternated and this is the extent of crop rotation now practiced. However, rotation experiments carried on by the Experiment Station at Lubbock indicate that lint yields obtained when cotton followed cotton have been consistently higher than lint yields in rotations in which cotton followed sorghum. So long as it is more profitable to produce cotton than sorghums, it seems desirable to plant cotton after cotton as often as possible and still safeguard soil resources.

The length of time that cotton can be grown continuously without detrimental results is not known for the area in general. Cotton has been grown continuously in some instances for 20 years with no apparent ill effects to the land. In other cases continuous growing of cotton for a comparatively short period resulted in lower yields and increased wind erosion. The ability of the operator to control wind erosion and maintain yields is most important in determining the cropping sequence, as well as the cropping system that can and should be followed.

WEEDS

Weeds are comparatively easy to control in the High Plains Cotton Area, owing largely to the low average annual rainfall and other climatic conditions that retard the germination of weed seed and limit the vegetative growth. The predominance of soils that permits early cultivation following rain is also a factor in weed control.

A large proportion of the weed pests of the area are annuals that are easy to destroy by timely cultivation. The sandy surface soil permits cultivation soon after a rain and makes it possible to destroy weeds in the early stages of growth when they are easiest to kill. The practice of planting in furrows and gradually filling the furrow by throwing soil toward the plants when cultivating, kills weeds in the row and eliminates much hand labor.

Of the perennial weeds found in the area, the blue-weed is the most common and the most difficult to eradicate. Frequent deep plowings are an effective method of eradicating the pest.[4] Farmers report good results with this method. Johnson grass, which is difficult to control in areas of greater rainfall and longer growing seasons, is easily controlled in this area owing to the frequent occurrence of temperatures well below freezing.

INSECTS

Insects have had little effect on crop yields. Climatic conditions seem to have placed the area beyond the reach of the cotton boll weevil. The cotton boll worm greatly damaged the cotton crop in 1928 in all but the northern part of the area but has caused little damage since. Cotton leaf worms appear occasionally but usually arrive too late in the season to do much damage. Cotton flea hoppers are sometimes responsible for scattered damage but considering the area as a whole the damage is slight. Spraying or dusting cotton to control insects is seldom done.

Various parts of the area have been under quarantine at times because of reported infestations of pink boll worm. However, no damage to cotton production from pink boll worm has ever been reported. Cotton and cotton products were permitted to move freely from quarantined localities when treated according to regulations.

Insects do very little damage to the grain sorghums. Occasionally the corn ear worm does some damage to compact-headed varities. Weevils sometimes damage stored sorghum grains during summer months, but are easily controlled by fumigation with an ethylene dichloride-carbon tetrachloride mixture.

PLANT DISEASES

Plant diseases are of minor importance in the area. Such diseases as are present are easily controlled, or have not been common enough to affect crop production greatly. No disease damage to cotton production has been reported as yet.

Diseases affecting the grain sorghums include kernel smut which is seed-borne and easily controlled by treating the planting seed, and milo blight which in the past has caused serious reduction in milo production but which has been brought under control through the development of blight resistant varieties.

A more serious problem is a fungus disease known as charcoal rot. This disease was found to be rather generally distributed over the western part of the state in 1938. It attacks practically all varieties of sorghums and causes premature ripening and lodging of the plant. It appears to do more damage during dry years than during wet years. There is no known treatment that will reduce the damage and control seems dependent upon the finding of resistant varieties.

ADAPTABILITY OF CROP ENTERPRISES

The physical characteristics of the area and the manner in which these characteristics affect production and production practices have been

[4]Texas Agricultural Experiment Station Bulletin No. 292, "The Blue-weed and Its Eradication."

discussed briefly in the foregoing sections. We now turn to a consideration of the individual enterprises adapted to the area. Information with respect to each enterprise is needed in evaluating the general considerations as well as the specific factors which tend to limit or further its expansion. In addition to such factors as market demands and relative profitableness, it is necessary to know the manner in which the different enterprises compete with each other or supplement and complement each other in the use of available resources, particularly labor, if sound conclusions relative to farm adjustments are to be drawn. In the following discussion the leading farm enterprises are considered in relation to the physical characteristics of the area and to the factors which determine the extent of their inclusion in farming systems.

Cotton grown in association with grain sorghums, forms the basis for the most common systems of farming found in the area. These are the principal crop alternatives available to farmers, and major differences in systems of farming center around the relative proportion of cropland devoted to cotton and to grain sorghums and the method of disposal of feed crops.

Cotton

Cotton has been the most important crop grown in the High Plains Cotton Area. According to census data for the eight counties entirely within the area, cotton occupied 53 per cent of the cropland harvested in 1929. During 1931 and 1932, the two years for which records were obtained previous to the advent of the Agricultural Adjustment Administration program, cotton was grown on approximately 44 per cent of the total cropland and cotton lint and seed sales amounted to two-thirds of the gross farm sales for cooperating farms. When cotton allotments are operative under the Agricultural Adjustment Administration program, participating farmers plant approximately one-third of their cropland to cotton and a great majority of farmers endeavor to grow their full cotton acreage allotment. An average of 94 per cent of the cooperating farmers grew cotton during the period of study.

Most of the cotton produced in the area is grown on sandy loam and clay loam soils. Young cotton is quite susceptible to damage from soil movement and a large part of the replanting of cotton results from damage of this nature. Because of greater difficulties in controlling soil-blowing, farmers plant very little cotton on the loamy fine sands.

The effects of a comparatively short growing season are minimized by planting early-maturing varieties of cotton and by using methods that accelerate plant development. As a rule, cotton is not chopped or thinned, since a thick stand retards vegetative growth and hastens maturity. For this reason, larger quantities of cottonseed are used for late plantings than for those made early in the season. The chances for a short growing season are increased with late planting which makes it advisable to plant quick-maturing varieties in preference to others. Consequently different varieties are sometimes used depending on whether planting is early or late.

Cotton varieties that make rapid growth under the low temperatures which often occur in the spring are best adapted to the area. Varieties that make small vegetative growth and have small leaves and thin burs are most likely to possess the essential qualities of earliness and the ability to make satisfactory yields from limited moisture. A high percentage of lint is desirable as this reduces harvesting and ginning costs. Storm resistance is also a desirable characteristic of cotton varieties for the High Plains.

Tests are conducted each year at the Agricultural Experiment Substation at Lubbock to determine the suitability of different varieties to the area. The results are available to all farmers and should be helpful in keeping them informed of improvements made in varieties from time to time.

Usual Practices in the Production of Cotton

Farmers of the area commonly list cotton land once previous to planting. On an average, about two-thirds of the land planted to cotton is knifed before planting. Replanting varies greatly from year to year, but on the average amounts to approximately one-fourth of the cotton acreage. Following planting, cotton is usually knifed once and cultivated twice with sweeps. Cotton is not chopped or thinned but it is all hoed once, while the weedy places are given a second hoeing. The number of cultivations and the amount of hoeing vary from year to year, depending largely on moisture conditions. Moisture stimulates weed growth and greater-than-average rainfall usually results in more cultivating and hoeing. An early crop usually requires more cultivation than a late crop.

Cotton picking is difficult after frost because the bolls are removed with very little pressure. As a result, snapping has largely replaced picking as the usual method of harvesting cotton. Snapping enables a worker to harvest approximately 50 per cent more lint than could be picked in the same length of time. Cotton is most apt to be picked when the bur is too green or damp to snap easily. This condition may occur either before frost, while the bur is still green, or following rain. Laborers prefer to snap rather than pick cotton, and it is usually difficult to get cotton picked when conditions are favorable for snapping.

Labor and Power Used to Grow Cotton

Labor and power required for cotton production with different sizes of equipment and types of power are shown in Figure 4. The labor saving possibilities of multi-row equipment may be seen by comparing the labor requirements for crop production with both horsepower and tractorpower. Under usual conditions, 10.45 hours of man labor and 20.90 hours of horse work were required per acre of cotton previous to harvest with one-row horse-drawn equipment. Power requirement per acre of cotton was not greatly reduced when two-row replaced one-row horse-drawn equipment, but man labor was reduced to 6.65 hours per acre. Hoeing accounts for 2.85 hours of labor per acre regardless of size and type of machinery. The efficiency of labor for machine operations was nearly doubled when two-row machinery with horsepower was used instead of single-row horse-drawn equipment.

With two-row tractor equipment 5.50 hours of man labor and 2.65 hours of tractor work were required per acre of cotton previous to har-

OPERATIONS	TIMES OVER	HORSE-DRAWN EQUIPMENT — ONE-ROW — MAN	HORSE-DRAWN EQUIPMENT — ONE-ROW — HORSE	HORSE-DRAWN EQUIPMENT — TWO-ROW — MAN	HORSE-DRAWN EQUIPMENT — TWO-ROW — HORSE	TRACTOR-DRAWN EQUIPMENT — TWO-ROW — MAN	TRACTOR-DRAWN EQUIPMENT — TWO-ROW — TRACTOR	TRACTOR-DRAWN EQUIPMENT — FOUR-ROW — MAN	TRACTOR-DRAWN EQUIPMENT — FOUR-ROW — TRACTOR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
		HOURS PER ACRE								PERIOD OPERATION USUALLY PERFORMED											
SEED BED PREPARATION:																					
LIST	1.0	1.20	4.80	.60	3.60	.50	.50	.30	.30												
KNIFE	,65	.70	1.40	.35	1.40	.25	25	15	15												
PLANT	1.25	1.65	6 60	.85	5.10	.55	.55	.30	.30												
CULTIVATION:																					
KNIFE	1.4	1.65	3.30	.80	3.20	.55	.55	.30	.30												
CULTIVATE	2.0	2. 40	4.80	1.20	4 80	.80	.80	.40	.40												
HOE	1.15	2.85		2.85		2.85		2.85													
TOTAL HOURS PREVIOUS TO HARVEST		10.45	20.90	6 65	18.10	5.50	2.65	4.30	1.45												
HARVEST																					
SNAP	2.0	13.50		13.50		13.50		13.50													
WEIGH IN FIELD	.15	.25		.25		.25		.25													
HAUL TO GIN	1.0	1.30	2.60	1.30	2.60	1.0	1.0	1.0	1.0												
TOTAL HARVESTING		15.05	2.60	15 05	2 60	14.75	1.0	14.75	1 0												
TOTAL ALL OPERATIONS		25.50	23.50	21 70	20.70	20.25	3 65	19.05	2 45												
USUAL DISTRIBUTION:																					
ONE-ROW HORSE-DRAWN EQUIPMENT — MAN-HOURS		25.50								2.26	.60	.60	.70	1.92	1.38	4.73	52		3.76	6.02	3 01
ONE-ROW HORSE-DRAWN EQUIPMENT — HORSE-HOURS			23.50							39	2.40	2 40	1.40	6.48	3 42	4.46	34		.52	1 04	65
TWO-ROW HORSE-DRAWN EQUIPMENT — MAN-HOURS				21.70						2.26	.30	.30	.35	97	.68	3.62	.43		376	6 02	3.01
TWO-ROW HORSE-DRAWN EQUIPMENT — HORSE-HOURS					20.70					.39	1.80	1.80	1.40	5.24	3.06	4.48	.32		.52	1.04	65
TWO-ROW TRACTOR-DRAWN EQUIPMENT — MAN-HOURS						20.25				2.20	.25	.25	.25	63	.45	3 22	45		3.68	5.93	2.94
TWO-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR-HOURS							3.65			.15	.25	.25	.25	.63	.45	72	.10		.25	.40	.20
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — MAN-HOURS								19.05		2.20	.15	.15	.15	.34	.26	2.85	.40		3.68	5 93	2.94
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR-HOURS									2.45	.15	.15	.15	.15	.34	.26	.35	.05		.25	.40	.20

Figure 4. Labor and power requirements for cotton production per acre by operations, with usual distribution by months and periods during which operations are usually performed. Tractor hours for hauling include one hour hauling with automobile and trailer.

vest. This represents a saving of 1.15 hours in man labor when compared with two-row horse-drawn machinery and a saving of 30 per cent in the labor used in connection with machine operations. An additional saving of 1.2 hours in the pre-harvest labor results from the use of four-row equipment.

As a rule, farmers harvest very little cotton with family labor but depend on hiring transient labor, largely Mexican and Negro, on a contract basis. Labor requirements for harvesting vary with the yield. The labor requirements for snapping and weighing in the field as shown in Figure 4 are the same for all kinds of power and types of equipment, because these are hand operations and are not affected by either size of equipment or kind of power. These data are based on an average yield of 182 pounds lint per acre. An average of approximately 1,900 pounds of snapped cotton was required to gin a 500-pound bale. An adult worker can snap an average of about 500 pounds of seed cotton per 10-hour day.

In general, farmers using horsepower hauled seed cotton to the gin with a wagon and team, while those with tractorpower used an automobile and trailer for this purpose. Those using wagon and team required 15.05 hours of man labor and 2.60 hours of horse work per acre for cotton harvesting, while the ones who hauled to the gin with a car and trailer used a total of 14.75 hours of man labor and one hour of car time.

Harvesting operations account for approximately 60 per cent of the total labor used in producing cotton when single-row equipment is used, as compared to approximately 70 per cent for two-row machinery, and 77 per cent for four-row equipment. As a consequence an extremely high labor peak occurs during the cotton harvesting season. This peak is relatively greater, the larger the power and equipment unit. An ample supply of transient labor has been an important factor in increasing the scale of cotton production to the point that growers are largely dependent on nonresident workers to gather the crop. There has been a tendency for the supply of cotton harvesting labor to become stabilized because of the way labor peaks of the winter vegetable areas and cotton harvesting throughout the state supplement each other to provide employment to a large number of people for a large part of the year. Large quantities of labor are needed for the production and harvesting of truck crops in the southern part of the state between the time cotton harvesting is finished in West Texas and commences again the following season in South Texas. It is common for transient laborers to commence picking cotton in the southern part of the state in early summer and to move north and west as harvest progresses, reaching the High Plains early in October.

If the supply of transient labor should be greatly reduced, drastic adjustments either in methods of harvesting cotton or in systems of farming would be necessary. These adjustments would be particularly drastic in this area since approximately 95 per cent of the labor used in harvesting cotton is hired. Farmers would have the alternatives of replacing hand snapping with sledding, stripping, or some other mechanical method of harvesting or of reducing cotton acreages according to the labor available for harvesting.

At the present time sledding is the only common method of mechanical harvesting. Sleds are simply constructed, cost very little, and can be built by local blacksmiths or by the farmers themselves. With a one-row sled one man with a team can harvest 4 to 6 acres or approximately two bales per day. It takes six to eight men to snap an equal quantity in a day.

In the past the saving of labor by sledding has not been sufficient to offset the greater cost of ginning and the lower prices received for sledded cotton. Consequently it has been used only in labor emergencies or in salvaging bollies or late-opened bolls. It does, however, represent a method by means of which the cotton of the area can be harvested should the labor supply fail.

More promising perhaps, although still in the experimental stage, is a stripper type harvester with a bur extractor unit attached which has been developed by the Agricultural Engineering Division of the Experiment Station. In recent tests it has gathered from 95 to 98 per cent of the seed cotton in the field with a loss of only a half grade in quality as compared to snapped cotton. A two-row machine of this type will reduce labor requirements for harvesting cotton by snapping by three-fourths and will permit the operator and his family to harvest the crop with very little or no outside help.

The relative importance of the different methods of harvesting cotton are shown in Table 2. The proportion of the crop snapped ranged from

Table 2. Percentage of cotton that was sledded, snapped and picked, 1931 to 1935, inclusive.

Year	Number of bales	Percentage of bales		
		Sledded	Snapped	Picked
		Per cent	Per cent	Per cent
1931	6,878	1.7	95.2	3.1
1932	6,310	4.0	95.4	.6
1933	3,960	.1	92.5	7.4
1934	750	.4	96.7	2.9
1935	3,408	.6	87.9	11.5
Average	4,246	1.9	93.6	4.5

88 per cent in 1935 to 97 per cent in 1934. The average for the period was approximately 94 per cent. Less than 2 per cent of the crop was harvested by sledding and 4.5 per cent was picked during the five-year period. The highest percentage picked was in 1935 when weather conditions were especially favorable to picking. Sledding was practiced only as a means of gathering late bolls.

Table 3. Seed cotton required per bale, proportion of cotton harvesting hired, and wage rates for cotton harvesting labor.

Year	Seed cotton required per 500-lb. bale			Proportion of harvesting hired		Harvesting rates	
	Sledded (Pounds)	Snapped (Pounds)	Picked (Pounds)	Snapped %	Picked %	Snapped (Dollars)	Picked (Dollars)
1931	2,037	1,937	1,469	86	83	.30	.45
1932	2,135	1,912	1,437	92	100	.30	.45
1933	2,718[1]	1,806	1,418	95	99	.45	.65
1934	2,343	1,992	1,443	85	—[2]	.80	—[2]
1935	2,430	1,879	1,407	95	95	.50	.70
Average	2,333	1,905	1,435	91	94		

[1]Only one farm reported sledding cotton.
[2]No cotton picked by hired labor.

The quantity of seed cotton and trash handled per 500-pound bale of lint cotton ginned is shown in Table 3. Approximately 2,350 pounds of sledded cotton, 1,900 pounds of snapped cotton and 1,450 pounds of picked cotton were ginned per bale of lint cotton obtained. It should be remembered, however, that sledded cotton here largely represents the remnant of the crop after the fields have been picked over once or twice and no doubt contains more trash than would sledded cotton if the bulk of the crop were so harvested.

Grain Sorghums

Grain sorghums, the basic grain and forage crop of the area, have been grown as a minor cash crop and to supply feed for livestock. Grain sorghums occupied nearly 36 per cent of the cropland harvested in 1929, according to census data for the eight counties entirely within the area. Cooperating farmers devoted a similar proportion of cropland to sorghums during 1931 and 1932, the two years for which records were obtained previous to the Agricultural Adjustment Administration program. Since the advent of the Agricultural Adjustment Administration program and the accompanying reduction in cotton acreage, there has been a tendency to increase the acreage devoted to sorghums. Census data for 1939 indicated that grain sorghums occupied about 56 per cent of the cropland harvested that year. Ninety-eight per cent of the cooperating farmers grew grain sorghums of some type during the period of study.

The optimum planting period for sorghums is longer than that for cotton so that feed crops can be planted after the optimum period for cotton planting is past. For this reason, sorghums may be substituted for cotton when the desired cotton acreage has not been established during the cotton planting season. Sorghums can be planted late enough to avoid the worst wind hazards.

Since sorghums are not so easily damaged by soil movement they tend to replace cotton on the lighter, sandier soils. The stalks and aftermath provide effective wind erosion control. Consequently sorghums may be planted almost exclusively on land which is highly susceptible to soil blowing.

Of the grain sorghums commonly found in the area, milo is grown primarily for grain, kafir and Hegari are used to provide both grain and forage while Sumac cane is grown for forage only. The Dwarf Yellow milo common to the South Plains is the most important crop planted for grain, grows three to four feet tall, has slender pithy stalks, tillers freely, grows the head on a recurved stem, and is relatively early maturing.[5] The seed are yellow buff-colored and usually bring a higher price on the market than white grain. Milo has been grown extensively for grain because of its earliness, its high grain yields, and the greater demand for it on the market. It is not used extensively for forage because forage yields are low and because the stalks are pithy and unpalatable.

In order to fill the need for a fast maturing grain sorghum, the Texas Agricultural Experiment Station has recently developed a quick-maturing milo, named Early Yellow, which matures approximately 20 days earlier

[5]Texas Agri. Exp. Station, Bulletin 459, "Grain Sorghum Varieties in Texas."

than the commonly grown Dwarf Yellow milo. According to tests made by the Texas Agricultural Experiment Substation at Lubbock, the grain yields obtained with the new, early strain have been almost as high as those of the Dwarf Yellow strain.

Grain yields of Texas Blackhul kafir were about equal to milo yields. The white seed are borne on an erect head and are fairly early-maturing. Kafir stalks are somewhat sweet, and fair yields of palatable forage were obtained on the farms studied.

Hegari has a rather coarse stem, tillers profusely and has numerous large leaves. The head is erect and the seed are white. Hegari grain yields averaged lower than either milo or kafir, but the forage yields were higher than either of these two. This variety is erratic in its behavior from year to year, and is less resistant to drought than milo or kafir. Under favorable conditions, high yields of both Hegari grain and forage are obtained, but very low yields may result during years of lower than average rainfall. Hegari may mature early or late depending on conditions. The crop may either be headed or bundled, according to the needs at harvest time. Hegari bundles are a popular feed for work stock and cows because grain is combined with a high quality roughage in about the correct proportion.

Sumac cane, commonly called Red Top, has been a consistently high yielding forage.[6] Sumac is strictly a forage variety, is of medium height and has a relatively short growing period. The quality of roughage is excellent.

A recently developed hybrid sorghum in which is combined the yellow grain of milo and the erect head of kafir is rapidly displacing other types of sorghums for the production of grain. It was especially designed for harvesting with combines and fills a long felt need in the area.

Because of the different practices involved, grain sorghums grown for grain and those grown for forage are treated as two separate crops in the discussion which follows concerning labor and power requirements for sorghum production. In the past milo has been the most common of the grain sorghums harvested for grain and cane the most representative of those harvested for forage.

Usual Practices and Labor and Power Used for Sorghum Production

Milo. Milo was grown on 96 per cent of the cooperating farms. Production of milo is characterized by a large proportion of machine work previous to harvest and a large amount of hand work during harvest. Land is ordinarily prepared for milo by listing. It is frequently planted early enough to avoid the necessity of knifing the lister beds before planting. Usually less than one-half of the acreage in milo was knifed previous to planting. It was necessary to replant approximately one-fourth of the milo crop. Early-planted milo usually received three cultivation operations. The crop was either knifed twice and cultivated once, or knifed once and cultivated twice. Late-planted milo was usually knifed once and cultivated once. Approximately one-third of the crop was normally gone over with a hoe. Labor and power requirements for different

[6] Texas Agricultural Experiment Station, Bulletin 496, "Forage Sorghums in Texas."

OPERATIONS	TIMES OVER	HORSE-DRAWN EQUIPMENT				TRACTOR-DRAWN EQUIPMENT						PERIOD OPERATION USUALLY PERFORMED											
		ONE-ROW		TWO-ROW		TWO-ROW			FOUR-ROW														
		HOURS PER ACRE																					
		MAN	HORSE	MAN	HORSE	MAN	TRACTOR	HORSE	MAN	TRACTOR	HORSE	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV.	DEC
SEED BED PREPARATION:																							
LIST	1.0	1.15	4.60	.60	3.60	50	.50		.30	.30													
KNIFE	.5	.50	1.00	.25	1.00	.20	.20		.10	.10													
PLANT	1.25	1.45	5.80	.75	4.50	.55	.55		.30	.30													
CULTIVATION:																							
KNIFE	1.3	1.45	2.90	.70	2.80	.50	.50		.25	.25													
CULTIVATE	1.3	1.55	3.10	.75	3.00	.50	.50		.25	.25													
HOE	.35	.75		.75		.75			.75														
TOTAL HOURS PREVIOUS TO HARVEST		6.85	17.40	3.80	14.90	3.00	2.25		2.00	1.25													
HARVEST. HEAD	1.0	4.45	8.90	4.45	8.90	4.45		8.90	4.45		8.90												
TOTAL HARVESTING		4.45	8.90	4.45	8.90	4.45		8.90	4.45		8.90												
TOTAL ALL OPERATIONS		11.30	26.30	8.25	23.80	7.45	2.25	8.90	6.45	1.25	8.90												
USUAL DISTRIBUTION:																							
ONE-ROW HORSE-DRAWN EQUIPMENT — MAN		11.30											.57	.58	.37	.71	2.32	1.91	.39	1.78	1.78	.89	
ONE-ROW HORSE-DRAWN EQUIPMENT — HORSE			26.30										2.28	2.32	.74	2.58	6.38	2.32	.78	3.56	3.56	1.78	
TWO-ROW HORSE-DRAWN EQUIPMENT — MAN				8.25									.30	.30	.19	.36	1.15	1.31	.19	1.78	1.78	.89	
TWO-ROW HORSE-DRAWN EQUIPMENT — HORSE					23.80								1.80	1.80	.76	2.04	5.50	2.24	.76	3.56	3.56	1.78	
TWO-ROW TRACTOR-DRAWN EQUIPMENT — MAN						7.45							.25	.25	.15	.27	.83	1.12	.13	1.78	1.78	.89	
TWO-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR							2.25						.25	.25	.15	.27	.83	.37	.13				
TWO-ROW TRACTOR-DRAWN EQUIPMENT — HORSE								8.90												3.56	3.56	1.78	
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — MAN									6.45				.15	.15	.07	.15	.43	.97	.08	1.78	1.78	.89	
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR										1.25			.15	.15	.07	.15	.43	.22	.08				
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — HORSE											8.90									3.56	3.56	1.78	

Figure 5. Labor and power requirements for milo production per acre when hand-headed, with the usual distribution by months, and periods of time during which operations are usually performed.

sized equipment and types of power are shown for milo production in Figure 5.

Requirements per acre previous to harvest range from 6.85 hours of man labor and 17.40 hours of horse work with single-row, horse-drawn equipment, to 2 hours of man labor and 1.25 hours of tractor work with four-row tractor equipment. For two-row horse-drawn equipment, 3.80 hours of man labor and 14.90 hours of horse work were used, but only 3 hours of man labor and 2.25 hours of tractor work were needed with two-row tractor outfits.

Hand-heading of milo and of other sorghums grown for grain was the common practice during the period of study. This operation required an average of 4.45 hours of man labor per acre and 8.9 hours of horse work or more than half of the total man labor requirements for the production of grain sorghums when two-row or larger machinery is used. A variation sometimes practiced when labor for hand-heading was difficult to obtain included binding, shocking and threshing. The binding and shocking were usually done at slack times during cotton harvesting. Once in the shock the threshing could be done at a convenient time.

With the development of yellow-grained, erect-headed grain sorghums, it has been possible to reduce greatly the labor requirements for harvesting through the use of small combines. This practice which has been adopted by a large majority of farmers during the past two years has reduced labor requirements for harvesting grain sorghums to approximately 40 per cent of the amount required in hand-harvesting. Labor and power requirements for grain sorghum production when harvesting was done by combining are shown in Figure 6.

Cane. Practices similar to those used in milo production are employed previous to harvest in the production of cane which was grown on 67 per cent of the farms. This crop usually receives only two cultivations, while hoeing is a minor operation confined to the more weedy portions of the field.

The labor and power requirements for cane production are shown in Figure 7. The labor needed previous to harvest is relatively small, varying from less than 6 hours of man work and 16 hours horse work with one-row horse equipment, to approximately 1.5 hours of man labor and 1.2 hours of tractor work with four-row outfits. Cane harvesting includes binding, shocking and stacking the bundles. Some farms with tractors are equipped with power take-off binders that cut two rows at a time and speed up binding. Two men with this type binder will bundle 20 acres in a 10-hour day, while one man with a horse-drawn binder will cut an average of 6 acres. Some farmers do not own a binder but find it more economical to hire their binding done on a contract basis.

Corn

Although corn was planted on 61 per cent of the farms studied, the acreage per farm was small. Corn was grown principally for household use and to finish meat hogs. Young corn is able to survive considerable damage from wind-blown soil and on the very light sandy soils, particularly in the western part of the area, corn rather than cotton is the cash crop.

OPERATIONS	TIMES OVER	HORSE-DRAWN EQUIPMENT						TRACTOR-DRAWN EQUIPMENT				PERIOD OPERATIONS USUALLY PERFORMED											
		ONE-ROW			TWO-ROW			TWO-ROW		FOUR-ROW													
		HOURS PER ACRE																					
		MAN	HORSE	TRACTOR	MAN	HORSE	TRACTOR	MAN	TRACTOR	MAN	TRACTOR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEED BED PREPARATION:																							
LIST	1.0	1.15	4.60		.60	3.60		.50	.50	.30	.30												
KNIFE	.5	.50	1.00		.25	1.00		.20	.20	.10	.10												
PLANT	1.25	1.45	5.80		.75	4.50		.55	.55	.30	.30												
CULTIVATION:																							
KNIFE	1.3	1.45	2.90		.70	2.80		.50	.50	.25	.25												
CULTIVATE	1.3	1.55	3.10		.75	3.00		.50	.50	.25	.25												
HOE	.35	.75			.75			.75		.75													
TOTAL HOURS PREVIOUS TO HARVEST		6.85	17.40		3.80	14.90		3.00	2.25	2.00	1.25												
HARVEST: COMBINE	1.0	1.20		.60	1.20		.60	1.20	.60	1.20	.60												
HAUL GRAIN	1.0	.60		.60	.60		.60	.60	.60	.60	.60												
TOTAL HARVESTING		1.80		1.20	1.80		1.20	1.80	1.20	1.80	1.20												
TOTAL ALL OPERATIONS		8.65	17.40	1.20	5.60	14.90	1.20	4.80	3.45	3.80	2.45												
USUAL DISTRIBUTION																							
ONE-ROW HORSE-DRAWN EQUIPMENT — MAN		8.65											.57	.58	.37	.71	2.32	1.91	.39	.45	.90	.45	
ONE-ROW HORSE-DRAWN EQUIPMENT — HORSE			17.40										2.28	2.32	.74	2.58	6.38	2.32	.70				
ONE-ROW HORSE-DRAWN EQUIPMENT — TRACTOR				1.20																.30	.60	.30	
TWO-ROW HORSE-DRAWN EQUIPMENT — MAN					5.60								.30	.30	.19	.36	1.15	1.31	.19	.45	.90	.45	
TWO-ROW HORSE-DRAWN EQUIPMENT — HORSE						14.90							1.80	1.60	.76	2.04	5.50	2.24	.76				
TWO-ROW HORSE-DRAWN EQUIPMENT — TRACTOR							1.20													.30	.60	.30	
TWO-ROW TRACTOR-DRAWN EQUIPMENT — MAN								4.80					.25	.25	.15	.27	.83	1.12	.13	.45	.90	.45	
TWO-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR									3.45				.25	.25	.15	.27	.83	.37	.13	.30	.60	.30	
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — MAN										3.80			.15	.15	.07	.15	.43	.97	.08	.45	.90	.45	
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR											2.45		.15	.15	.07	.15	.43	.22	.08	.30	.60	.30	

Figure 6. Labor requirements for grain sorghum production per acre by operations when harvested by combine, with the usual distribution by months, and periods of time during which operations are usually performed. Tractor hours for hauling include 0.60 hour for hauling with automobile and trailer.

OPERATIONS	TIMES OVER	HORSE-DRAWN EQUIPMENT ONE-ROW HOURS PER ACRE MAN	HORSE-DRAWN EQUIPMENT ONE-ROW HORSE	HORSE-DRAWN EQUIPMENT TWO-ROW MAN	HORSE-DRAWN EQUIPMENT TWO-ROW HORSE	TRACTOR-DRAWN EQUIPMENT TWO-ROW MAN	TRACTOR-DRAWN EQUIPMENT TWO-ROW TRACTOR	TRACTOR-DRAWN EQUIPMENT TWO-ROW HORSE	TRACTOR-DRAWN EQUIPMENT FOUR-ROW MAN	TRACTOR-DRAWN EQUIPMENT FOUR-ROW TRACTOR	TRACTOR-DRAWN EQUIPMENT FOUR-ROW HORSE	PERIOD OPERATION USUALLY PERFORMED JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEED BED PREPARATION:																							
LIST	1.0	1.15	4.60	.60	3.60	.50	.50		.30	.30													
KNIFE	.75	.85	1.70	.45	1.80	.30	.30		.20	.20													
PLANT	1.10	1.30	5.20	.70	4.20	.50	.50		.25	.25													
CULTIVATION:																							
KNIFE	1.0	1.25	2.50	.60	2.40	.40	.40		.25	.25													
CULTIVATE	1.0	1.20	2.40	.60	2.40	.40	.40		.20	.20													
HOE	.10	.25		.25		.25			.25														
TOTAL HOURS PREVIOUS TO HARVEST		6.00	16.40	3.20	14.40	2.35	2.10		1.45	1.20													
HARVEST: BIND	1.0	1.45	4.35	1.45	4.35	1.00	.50		1.00	.50													
SHOCK	1.0	1.75		1.75		1.75			1.75														
HAUL & STACK	1.0	3.65	3.65	3.65	3.65	3.65		3.65	3.65		3.65												
TOTAL HARVESTING		6.85	8.00	6.85	8.00	6.40	.50	3.65	6.40	.50	3.65												
TOTAL ALL OPERATIONS		12.85	24.40	10.05	22.40	8.75	2.60	3.65	7.85	1.70	3.65												
USUAL DISTRIBUTION:																							
ONE-ROW HORSE-DRAWN EQUIPMENT — MAN		12.85										1.25	.57	.58	.42	1.08	1.27	1.23	.85	1.60	1.60		2.40
ONE-ROW HORSE-DRAWN EQUIPMENT — HORSE			24.40									1.25	2.28	2.32	.84	3.46	3.84	2.46	1.20	2.16	2.19		2.40
TWO-ROW HORSE-DRAWN EQUIPMENT — MAN				10.05								1.25	.30	.30	.22	.58	.65	.60	.55	1.60	1.60		2.40
TWO-ROW HORSE-DRAWN EQUIPMENT — HORSE					22.40							1.25	1.80	1.80	.88	3.02	3.30	2.40	1.20	2.16	2.19		2.40
TWO-ROW TRACTOR-DRAWN EQUIPMENT — MAN						8.75						1.25	.25	.25	.15	.40	.45	.40	.45	1.37	1.38		2.40
TWO-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR							2.60						.25	.25	.15	.40	.45	.40	.20	.25	.25		
TWO-ROW TRACTOR-DRAWN EQUIPMENT — HORSE								3.65				1.25											2.40
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — MAN									7.85			1.25	.15	.15	.10	.22	.25	.23	.35	1.37	1.38		2.40
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — TRACTOR										1.70			.15	.15	.10	.22	.25	.23	.10	.25	.25		
FOUR-ROW TRACTOR-DRAWN EQUIPMENT — HORSE											3.65	1.25											2.40

Figure 7. Labor and power requirements for cane production per acre by operations, with usual distribution by months, and periods of time during which operations are usually performed.

OPERATIONS		TIMES OVER	HORSE-DRAWN EQUIPMENT				TRACTOR-DRAWN EQUIPMENT						PERIOD OPERATION USUALLY PERFORMED											
			ONE-ROW		TWO-ROW		TWO-ROW			FOUR-ROW														
			HOURS PER ACRE																					
			MAN	HORSE	MAN	HORSE	MAN	TRACTOR	HORSE	MAN	TRACTOR	HORSE	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEED BED PREPARATION:																								
LIST		1.0	1.15	4.60	.60	3.60	.50	.50		.30	.30													
KNIFE		.50	.60	1.20	.30	1.20	.20	.20		.15	.15													
PLANT		1.10	1.30	5.20	.70	4.20	.45	.45		.25	.25													
CULTIVATION:																								
KNIFE		1.10	1.25	2.50	.60	2.40	.40	.40		.25	.25													
CULTIVATE		1.25	1.50	3.00	.75	3.00	.50	.50		.25	.25													
HOE		.30	.65		.65		.65			.65														
TOTAL HOURS PREVIOUS TO HARVEST			6.45	16.50	3.60	14.40	2.70	2.05		1.85	1.20													
HARVEST: SNAP		1.0	3.10	6.20	3.10	6.20	3.10		6.20	3.10		6.20												
TOTAL HARVESTING			3.10	6.20	3.10	6.20	3.10		6.20	3 10		6.20												
TOTAL ALL OPERATIONS			9.55	22.70	6.70	20.60	5.80	2.05	6.20	4.95	1.20	6.20												
USUAL DISTRIBUTION:																								
ONE-ROW HORSE-DRAWN EQUIPMENT	MAN		9.55											.57	.58	1.03	.98	1.39	1.59	.30			1.55	1.55
	HORSE			22.70										2.28	2.32	2.92	3.10	3.38	1.88	.60			3.10	3.10
TWO-ROW HORSE-DRAWN EQUIPMENT	MAN				6 70									.30	.30	.53	.51	.69	1.12	.15			1.55	1 55
	HORSE					20.60								1 80	1.80	2.58	2.66	3.08	1.88	.60			3.10	3.10
TWO-ROW TRACTOR-DRAWN EQUIPMENT	MAN						5.80							.25	.25	.35	.33	.46	.96	.10			1.55	1.55
	TRACTOR							2.05						.25	.25	.35	.33	.46	.31	.10				
	HORSE								6.20														3.10	3.10
FOUR-ROW TRACTOR-DRAWN EQUIPMENT	MAN									4.95				.15	.15	.23	19	.26	.82	.05			1.55	1.55
	TRACTOR										1 20			.15	.15	.23	19	.26	.17	.05				
	HORSE											6.20											3.10	3.10

Figure 8. Labor and power requirements for corn production per acre by operations, with usual distributions by months and periods of time during which operations are usually performed.

The cultural practices for corn are similar to those for grain sorghums. Corn has a relatively long optimum planting period and is often planted sufficiently early that it is not necessary to knife the beds previous to planting. After planting, corn is usually knifed once and cultivated once. Early corn sometimes gets two cultivations. The crop is not thinned and may or may not be hoed, depending on the number of big weeds present. The labor and power required to grow corn up to harvest are quite similar to the requirements for milo and cane. (See Figure 8). Corn is snapped by hand but this operation requires only 3.10 hours of man labor as compared to 4.45 hours per acre for hand-headed milo. Corn will stand a long time after maturity without damage, so that harvest can be postponed until it does not interfere with the harvesting operations of other crops.

Sudan

Sudan was grown for summer pasture and a few acres of this crop were found on 88 per cent of the farms. Farmers have found that considerably more forage can be produced on a given acreage by planting Sudan than by leaving the native turf. Sudan is occasionally cut for forage and may be harvested for seed. As a cash crop, Sudan seed is most common in the northern and western parts of the area. Sudan stubble and aftermath is an effective cover for wind erosion control, but land in Sudan that has been grazed heavily until frost, is subject to severe blowing.

Sudan production entails the same general operations as those used to grow other row crops. When grown for pasture, Sudan is most often given one knifing and one cultivation after planting. The crop may or may not be hoed. Labor and power requirements for growing Sudan pasture are given in Figure 9. In case Sudan is grown for seed, the harvesting operations consist of binding and shocking, which have similar labor and power requirements as binding and shocking cane (See Figure 7). Sudan is usually threshed out of the shock.

Wheat

Wheat is the most commonly grown small grain and is used principally for winter and spring pasture, although the livestock may be taken off early enough in the spring to permit a crop of grain to mature and be harvested. During the period of the study, small grain occupied an average of less than 5 per cent of the cropland of cooperating farmers.

Because the heavy soils of the area offer greater resistance to blowing, wheat frequently partially replaces cotton as a cash crop on these soil types. The extent that cotton is replaced by wheat, or *vice versa,* is usually determined by the availability of moisture at seeding time and by the comparative prices of the two crops.

Small grains planted on light sandy soils frequently fail to make sufficient fall growth to check erosion and to prevent being blown out during the winter and spring. When moisture is plentiful and seeding fairly early, fall growth may be sufficient to avoid this difficulty. Small grains should not be seeded when soil moisture is deficient at planting time.

Small grain production requires different equipment than is used for row crops and competes with row crops for labor. Grain drilling should be

OPERATIONS		TIMES OVER	HORSE-DRAWN EQUIPMENT				TRACTOR-DRAWN EQUIPMENT				PERIOD OPERATIONS USUALLY PERFORMED											
			ONE-ROW		TWO-ROW		ONE-ROW		TWO-ROW													
			HOURS PER ACRE																			
			MAN	HORSE	MAN	HORSE	MAN	TRACTOR	MAN	TRACTOR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEED BED PREPARATION:																						
LIST		1.0	1 15	4.60	.60	3.60	.50	.50	.30	.30												
KNIFE		.5	.60	1 20	.30	1 20	20	20	15	.15												
PLANT		1.15	1.30	5.20	75	4.50	55	.55	.35	35												
CULTIVATION:																						
KNIFE		1.20	1 40	2.80	75	3.00	.50	.50	.30	.30												
CULTIVATE		.70	85	1 70	.45	1 80	35	.35	.15	15												
HOE		.40	90		90		90		.90													
TOTAL HOURS PER ACRE			6.20	15.50	3 75	14.10	3.00	2.10	2.15	1.25												
USUAL DISTRIBUTION																						
ONE-ROW HORSE-DRAWN EQUIPMENT	MAN		6 20									.57	.58	.60	2.24	.97	1.24					
	HORSE			15 50								2.28	2.32	1 20	7.08	1.94	.68					
TWO-ROW HORSE-DRAWN EQUIPMENT	MAN				3 75							30	30	.30	1.25	52	1.08					
	HORSE					14.10						1 80	1.80	1 20	6.50	2.08	.72					
TWO-ROW TRACTOR-DRAWN EQUIPMENT	MAN						3.00					.25	25	.20	.88	.37	1.05					
	TRACTOR							2.10				25	25	20	88	.37	.15					
FOUR-ROW TRACTOR DRAWN EQUIPMENT	MAN								2.15			.15	15	.15	.55	.19	.96					
	TRACTOR									1.25		.15	.15	.15	.55	.19	.06					

Figure 9. Labor and power required for Sudan production per acre by operations, with usual distribution by months and periods of time during which operations are usually performed.

OPERATIONS	TIMES OVER	HORSE-DRAWN EQUIPMENT HOURS PER ACRE MAN	HORSE	TRACTOR	TRACTOR-DRAWN EQUIPMENT MAN	TRACTOR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
DRILL	1.0	.55	2.20		.45	.45												
TOTAL HOURS PREVIOUS TO HARVEST		.55	2.20		.45	.45												
HARVEST:																		
COMBINE	1.0	1.00		.50	1.00	50												
HAUL IN GRAIN	1.0	.50	1.00		50	.50												
TOTAL HARVESTING		1.50	1.00	.50	1.50	1.00												
TOTAL ALL OPERATIONS		2.05	3.20	.50	1.95	1.45												
USUAL DISTRIBUTION:																		
HORSE DRAWN EQUIPMENT — MAN		2.05										1.00	.50		.30	.25		
HORSE DRAWN EQUIPMENT — HORSE			3.20									.66	.34		1.20	1.00		
HORSE DRAWN EQUIPMENT — TRACTOR				.50								.33	17					
TRACTOR-DRAWN EQUIPMENT — MAN					1.95							1.00	.50		.25	.20		
TRACTOR-DRAWN EQUIPMENT — TRACTOR						1.45						67	.33		.25	.20		

Figure 10. Labor and power requirements for wheat production per acre by operations, with usual distribution by months and periods of time during which operations are usually performed. Tractor hours for hauling include 0.50 hour hauling with automobile and trailer.

done during the busy harvest season for row crops and grain is normally harvested during the time of planting or the important first cultivation.

About 75 per cent of the wheat is sown after cotton or grain sorghums without further seed bed preparation. In most other cases wheat land is flat-broken previous to seeding. In some instances the land is also harrowed. Harvesting is usually done by combine on a contract basis, as very few farmers own combines.

Labor and power requirements for growing and harvesting wheat are shown in Figure 10. These are based on the most common practice of drilling wheat without previous seed bed preparation. When it is advisable to flat-break wheat land previous to seeding, the labor and power requirements would be increased according to the type of power and equipment used. Approximately 5 acres per 10-hour day can be flat-broken with a two-disc horse-drawn plow. With this type of power and equipment 2 hours of man labor and 8 hours of horse work are required to flat-break an acre. Seven acres per day day can be flat-broken with a three-disc tractor-drawn plow and approximately 1.45 hours an acre of man and tractor work will be required. Labor requirements for harrowing will range from 0.45 hour per acre with horsepower to 0.25 hour per acre with tractorpower. When small grains are utilized entirely for pasture, drilling is the only field operation commonly performed in connection with the crop.

Distribution of Labor and Power in Crop Production

The usual monthly distribution of the labor required to produce the six principal crops grown in the area when two-row tractor equipment is used is shown in Figure 11. The two-row tractor is by far the most common power unit in use.

Crop work during the two or three months previous to planting does not utilize all of the operator's time. He usually takes advantage of this slack period to make repairs and to put his equipment in good shape for the rush work that follows. The planting season is a very busy time since the period of favorable planting conditions is often short. Of the two major crops, cotton has a rather narrow range in planting dates while grain sorghums may be planted over a considerably longer period.

Variations in moisture conditions contribute to the wide range in the time during which crop operations are performed. For example, row crops are usually planted in May and June, but moisture conditions largely determine the actual planting dates. Cultivation is most effective following rain, hence rains largely determine the dates when these operations are performed.

Both cotton and feed are summer crops and their production results in two peak labor periods. The first labor peak occurs in July when a major portion of the hoeing is done. Hoeing is usually necessary during the time that farmers are busy cultivating and is added work during an already busy period.

The second and greatest peak demand for labor is during the harvest season. Cotton, forage sorghums, and all except early-planted grain sorghums are ready to harvest during October and November. Corn normally matures during these months; corn is not damaged by late harvesting, and is usually gathered after the harvest of other crops is completed. Early

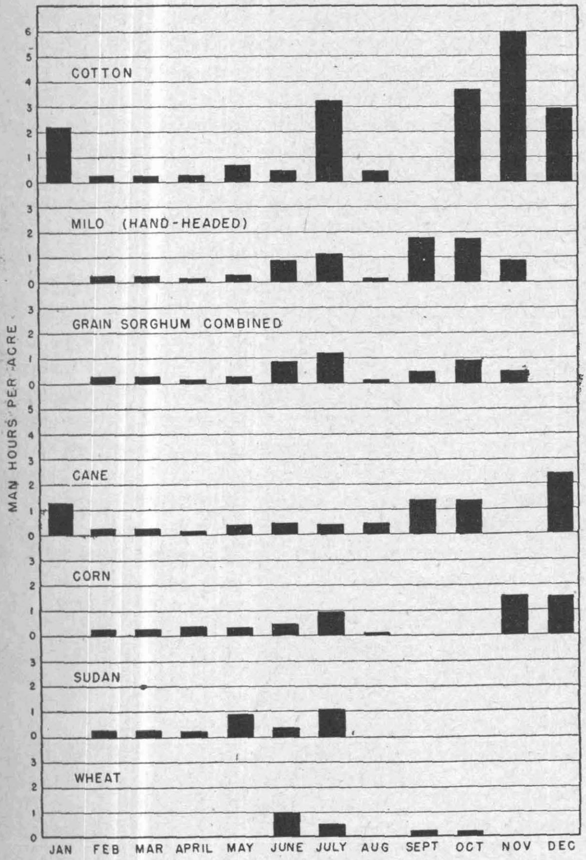

Figure 11. A comparison of the distribution by months of labor requirements per acre for six principal crops.

milo is usually harvested in September before cotton is open. By making early milo plantings when moisture conditions permit, farmers can effect some adjustment in the distribution of harvesting labor. It is also possible to make some adjustment in the competition of cotton and grain sorghums for harvesting labor by using kafir or Hegari for late plantings. Kafir and Hegari both stand up well after ripening, and heading can be deferred for some time without serious loss. The use of "combine sorghums" for grain will help reduce labor demands during the harvest period.

The heaviest demand for power occurs during May, June, and July when crops are planted and cultivated. When the cotton acreage has been established fairly early in the season, farmers sometimes spread the task of cultivation over a longer period by working out the cotton crop before planting late feed crops.

Timeliness of Operations

Timeliness in performing tillage operations may check or control erosion, effect labor savings, effect the cropping system, and increase yields. Timeliness in the performance of field operations is very important but often difficult of attainment. What may be timely under one set of conditions may be the opposite under another.

Timeliness of listing is important to the extent that it checks or controls wind erosion. Listing is most effective when the soil contains sufficient moisture to cohere slightly rather than completely pulverize. The nearer conditions are to the optimum at the time of listing the more effective the operation. Early listed land may dry out and become a blow hazard before planting time. Results obtained at the Texas Agricultural Experiment Station favor late seed bed preparation. However, it is better to take advantage of optimum soil moisture conditions than to wait until a particular date and do a poor job of listing.

Weeds are more easily destroyed when small and timely cultivation controls weed growth with a saving of both machine and hoe work. This is especially important to a farmer whose labor and equipment are fully occupied. Any method that will reduce the amount of hired labor or release labor for other productive purposes without lowering the quality of work will increase farm earnings.

Since the period favorable for cotton planting is often short, timely planting may determine whether or not the desired cotton acreage is established. Poor stands or extra replantings are often avoided by well-timed plantings, and loss of young crops is often prevented by timely field work.

Materials and Services Used in Crop Production

The usual quantities of seed and twine used and the usual cost of special services hired for crop production are shown in Table 4. Farmers

Table 4. Material requirements of crops[1]

Crop	Seed per acre (Pounds)	Twine per acre (Pounds)	Ginning cost per cwt. (Dollars)	Bagging & ties cost per bale (Dollars)	Contract binding cost per acre (Dollars)	Contract combining cost per acre (Dollars)	Threshing cost per cwt. (Dollars)
Cotton	26.0	—	.25	1.25	—	—	—
Milo	1.7	—	—	—	—	—	.10
Cane	5.7	2.2	—	—	1.00	—	—
Corn	4.4	—	—	—	—	—	—
Sudan	8.0	1.6	—	—	1.00	—	.25
Wheat	30.0	—	—	—	—	1.50	—

[1]Contract rates are for the period 1931-1935 inclusive.

in the area commonly purchase and plant a sufficient amount of pure cottonseed each year to supply the bulk of the seed for the following crop. This practice provides good planting seed at relatively low costs. Grain sorghum seed are a relatively small item of expense and many farmers prefer to buy them when prices are reasonable rather than care for home-selected seed. The prices paid for ginning, bagging and ties, binding, combining, and threshing were obtained from the cooperating farms and are representative of the costs during the period of the study.

Crop Yields

The average per acre yields obtained by cooperating farmers are shown in Table 5. Cotton yields are given for 9 years. Yields for milo heads, Hegari bundles, and cane bundles are shown for 7 years, and all

Table 5. Yield per acre of specified crops on farms studied, 1931 to 1936, inclusive, and six-year average for crops other than cotton. Additional data on cotton were obtained for 1928, 1929, and 1930.

Crops		1928[1] (107 farms)	1929[1] (124 farms)	1930[1] (168 farms)	1931 (141 farms)	1932 (138 farms)	1933 (127 farms)	1934 (139 farms)	1935 (138 farms)	1936 (70 farms)	Average yield for period available	6-year average yields 1931-1936
Cotton — lint	(Pounds)	90	160	116	245	226	233	39	177	174	162[2]	182
Cottonseed	(Pounds)	—	—	—	368	363	353	57	267	245	265	265
Milo heads	(Pounds)	—	—	951	1,792	1,532	1,245	204	1,087	996	1,115[3]	1,143
Milo bundles	(Pounds)	—	—	—	2,813	3,407	1,694	531	1,500	2,906	2,142	2,142
Kafir heads	(Pounds)	—	—	—	1,652	1,263	1,721	43	1,522	787	1,155	1,155
Kafir bundles	(Pounds)	—	—	—	3,833	3,037	2,366	1,273	2,750	2,326	2,598	2,598
Hegari heads	(Pounds)	—	—	—	1,481	1,064	957	250	1,743	1,050	1,091	1,091
Hegari bundles	(Pounds)	—	—	2,032	3,717	3,750	2,821	736	2,954	2,768	2,683[3]	2,791
Cane bundles	(Pounds)	—	—	2,568	3,734	4,380	2,650	507	3,712	4,048	3,085[3]	3,172
Corn	(Bushels)	—	—	—	17	16	14	.8	15	9	12	12
Wheat	(Bushels)	—	—	—	14	11	1	6.5	5	10	7.8	7.8
Grain pasture	(Pasture days)	—	—	—	102	73	47	28	25	44	53	53.2
Sudan pasture	(Pasture days)	—	—	—	102	125	69	22	73	86	80	79.5
Sudan seed	(Pounds)	—	—	—	561	448	386	150	418	301	377	377

[1]Data obtained by means of preliminary survey.
[2]Nine-year average.
[3]Seven-year average.

other crop yields are for a 6-year period. A 9-year average yield of 162 pounds of lint was obtained on the farms studied. Cottonseed yields were available for 6 years, and an average of 265 pounds of seed were produced in conjunction with a lint yield of 182 pounds.

An average per acre yield of 1,155 pounds of heads was obtained for kafir, followed by 1,115 pounds for milo and 1,091 pounds for Hegari. Cane was the highest yielding forage crop with an average of 3,085 pounds per acre. Average per acre forage yields of 2,683 pounds, 2,598 pounds, and 2,142 pounds were obtained from Hegari, kafir, and milo, respectively. A 6-year average of 12 bushels per acre of corn was obtained, while wheat yielded an average of only 7.8 bushels per acre. Small grain furnished the only succulent winter and early spring pasture, and one acre yielded an average of 53 days grazing for a mature horse or cow or their equivalents. On the same basis, Sudan furnished an average of 80 days of summer pasture per acre.

The crop yield data for the farms studied indicate wide variations both in the average yields obtained from year to year on all farms and the yields obtained during the same year on different farms. Cotton yields for all farms varied from an average of 245 pounds per acre in 1931 to 39 pounds per acre in 1934. Even greater farm-to-farm variation was observed. In 1931 conditions for the area as a whole were favorable for crop production and yields in general were less erratic than during the other years of the study, yet yields of lint cotton obtained on the farms studied varied from 444 pounds to 57 pounds per acre. Climatic variations account for a large part of these yield differences.

In Texas Agricultural Experiment Station Bulletin No. 568 crop yields are shown to be one of the most important factors affecting farm earnings. Of the farms studied, those with high incomes obtained yields noticeably higher than average for all farms, while the yields obtained on low-income farms were consistently lower than average.

ADAPTABILITY OF LIVESTOCK ENTERPRISES

Livestock production has occupied a minor place in the organization of the great majority of farms in the area. Numerous factors have contributed to this situation. Some of the most important of these have been: the relative advantage of cotton over feed crops, previous experience and training of the farmers of the area, and the extreme year-to-year variations in the amount of feed available.

Farmers tend to specialize in the enterprise or combination of enterprises that promise the greatest profit. When there is freedom of choice, the selection of enterprises is largely influenced by relative costs and returns. Based on the prices that have prevailed and the yields that have been obtained, cotton has offered greater opportunities for profit than grain sorghums. This has been true regardless of whether the feed was marketed as cash grain or utilized to produce livestock products for sale. Cotton accounted for 64 per cent of the cash receipts of the farms studied. Other important income sources and their respective proportion of cash receipts were as follows: grain sorghums and other crops, 9 per cent; cattle and dairy products, 9 per cent; poultry and eggs, 5 per cent; and hogs, 3 per cent.[7]

A large majority of the farmers in the area migrated from the older

[7]For additional detail see Texas Agricultural Experiment Station Bulletin No. 568, "An Economic Study of Farm Organization and Operation in the High Plains Cotton Area of Texas."

cotton sections of Texas and Oklahoma. In general, these people have obtained farm experience in regions of specialized production of crops, principally cotton, and have had relatively little experience with livestock. Personal aptitude and preference influence farm organization in that farmers tend to follow the system of farming with which they are familiar. Since the farmers in the area have had more experience growing crops than livestock, it naturally follows that they would stress crop production.

The area depends to a large extent upon cultivated crops for its feed supply. When the area was utilized for cattle ranching, native grass made up the principal feed supply. During the period of breaking out sod, it was necessary for farmers to decide on the proportion of land to remain in grass and the proportion to be put in cultivation. Once plowed up, it is a very slow and difficult task to reestablish native grass. At first, it was common to leave a considerable part of the farm unbroken. Later, most of this land was put into cultivation, leaving only a small area of grassland near the farmstead or on the steeper slopes of lake beds. This change has taken place because it was found that cultivated crops were more profitable. More grazing can be obtained per acre from Sudan than from native grasses.

An ample and reliable supply of feed is required for livestock production. As a rule, livestock enterprises are most profitable when the feed supply can be consistently maintained from year to year. A study of the crop yields (See Table 5) indicates that extreme variations are common and that years of abundant feed crops are often followed by periods of low yields. For example, the years 1931 and 1932 were years of large feed crops, while again in 1933 feed yields were fair on most farms. In 1934, a year of extreme drought, feed yields were only 20 per cent of the previous 3-year average and an extreme shortage of feed resulted. Similar feed shortages occurred as a result of the droughts of 1917, 1918, 1929, and 1930. It is not uncommon in years when crops are generally good to find some communities in which yields have been lowered by lack of timely rainfall or by hail damage.

It has been pointed out that because of climatic factors frequent adjustments in the cropping system are necessary to fit the opportunities for planting. Feed crops often replace cotton in the cropping system when a stand cannot be established on desired cotton acreage during the cotton planting period. When favorable growing conditions accompany the large feed acreage thus obtained a large surplus of feed results for which the grower must find an outlet. The common practice is to sell on the cash grain market. Since the feed surplus is usually accompanied by a low price low returns are commonly realized. Such a feed surplus may serve as the basis for a livestock feeding enterprise or for the expansion of the regular livestock enterprises. Expansion of the breeding herds on the basis of an occasional feed surplus is likely to result in a feed shortage during years of normal or below normal feed production.

An irregular feed supply usually results in many problems for livestock producers, and may cause frequent and rapid adjustments in the enterprise. When a feed shortage occurs, farmers usually have two alternatives. They may buy feed or they may sell a part of the livestock. Either practice may result in a heavy loss to the operator. Short feed crops are usually accompanied by high feed prices while the sending of abnormally large numbers of livestock to market, may so adversely affect prices as to be disastrous to the producer. Not only are farmers often forced to liquidate surplus livestock but also a part of the breeding herd normally maintained. Such conditions make it difficult to carry on constructive breeding work.

Results obtained on the farms studied indicate the importance of having a reserve supply of feed during a severe drought such as occurred in 1934. Farmers with a supply of feed at the start of the 1934 crop year sufficient to feed their livestock one year or longer made more money than those with only six months' supply or less. The advantage in earnings on farms with larger feed reserves resulted from: (1) smaller purchases of high-priced feed; (2) the maintenance of livestock production at normal levels; (3) in some cases the sale of feed at relatively high prices. A feed reserve serves the same purpose as a cash reserve. A farmer with a reserve of feed can avoid expensive purchases of feed that require cash or credit, or surplus feed becomes a source of cash when sold. Farmers who maintain large feed reserves have the alternative of selling feed for high prices rather than feeding it. They may choose the method which offers the greater opportunity for profit. When feed is so high that the feeding operations are carried on at a loss, it may be more profitable to liquidate livestock and sell feed rather than feed it. In this case, any loss suffered by disposing of the livestock will be offset by the high income from the feed sold. In a case of this kind the farmer with no feed reserve will lose money whether he liquidates his livestock at a loss or whether he goes ahead and finishes them at a loss. Feed reserves are usually established when supplies are large and feed prices are low.

It is possible for farmers in the region to store feed for use during periods of crop failure or low yields. The sub-humid atmosphere facilitates curing and preserving feed, and when properly handled, the feeds grown can be kept for a long period at a low cost and with small deterioration. Grain may be stored either as heads or threshed grain. Threshed grain is more compact and has the advantage of requiring less storage space, but is more likely to be damaged if not kept dry and is more subject to weevil damage. Threshed grain should be treated at intervals to control weevils. Heads stack easily and can be kept dry with relatively inexpensive equipment. When granaries or barns are not available, farmers frequently stack headed feed in a well drained place, cover with bundle feed and keep it a year with little loss. This type of feed can be stored much longer under a waterproof roof. A wire netting or picket enclosure with a waterproof roof is relatively inexpensive to build and makes a satisfactory storage for headed feed. Heads in this type storage have remained in good shape for three years. It is important that all feeds be well cured before storing.

Since very few farmers have barns in which to store forage, bundle feed is commonly stacked out of doors. The length of time that bundles can be stored in this way depends on the length of time that the stack sheds water. Careful stacking is very important, particularly if bundles are to remain stacked for a long period. Instances are known of bundles being stacked longer than five years without serious damage to the feeding value of the feed. When kept for long periods, a small amount of forage on the outside of the stack is exposed to weather and is wasted. Retopping the stack when needed will often prevent extensive waste. Forage that has been stacked for a long period is brittle and should be carefully handled to prevent waste in feeding. In general, farmers of the area do not consider the loss of forage which results from stacking bundles out of doors sufficient to warrant the building of barns for storage.

In recent years the trench silo has come into use as a method of storing feed. Farmers report the trench silo a satisfactory storage for feed that is to be used up during the fall, winter, and spring following harvest, provided sufficient silage is fed to avoid the molding of exposed feed. It has also been demonstrated that feed surpluses may be satisfactorily stored in trench silos for longer periods of time.

In addition to workstock, the livestock usually found on the farms studied were dairy cattle, hogs, and poultry. Although some beef cattle and sheep have been full-fed on farms, so far beef cattle feeding has been a very minor enterprise among farmers. Chickens are the principal type of poultry although turkeys are raised on a few farms each year. The few small flocks of sheep that may be found are usually on farms having a relatively large acreage of native grass pasture.

Dairy Cattle

Dairy cattle were the most important livestock produced on the farms studied. Sales of dairy products and cattle made up 9 per cent of the gross sales. This was greater than the income obtained from any other livestock enterprise. A large percentage of the cattle on these farms were of the dairy type.

Dairy cattle are maintained on practically all farms to supply milk and butter for the farm family. Although the number of milk cows on different farms varies considerably, herds of 4 to 6 cows are most common. A limited number of farmers have access to a market for whole milk but most of the product over and above that used by the farm family is sold as sour cream. Calves not needed for herd replacement supply meat for the farm family or are sold as calves or yearlings mainly for beef.

Although small, the dairy enterprise was a source of regular income which was obtained without materially reducing production from other phases of the farm business. Weekly sales of dairy products helped provide for the current farm and household expenses and in this way help reduce the need for credit.

Although very few farms have registered cattle, the majority of the dairy cows are high grade. Jerseys are the predominant breed. They are efficient producers of butterfat, and have proved well adapted to the area. During periods of very low butterfat prices, there has been some tendency to shift toward dual purpose cattle in order to obtain a good calf for beef production as well as a fair amount of butterfat.

Management of the dairy herd and of the dairy products sold is not complicated. No artificial cooling or proceesing is required for sour cream. Cream is usually marketed once or twice a week at the same time that household purchases are made. Expensive housing is not required because of the mild climate. Sheds that open on the south furnish the needed shelter and are in common use in the area. On farms that sell some dairy products, the buildings, equipment, acreage in native pasture, and general overhead are not greatly different than on similar-sized farms that keep cows only to supply products for the home. A material expansion in the number of cows maintained, however, would necessitate more buildings and equipment on most farms. Stock water is not a limiting factor in the production of dairy products. An adequate and economical supply is obtained by means of wells and windmills.

Because of the small size of most herds it is not practical for all farmers to own a bull. Bulls are usually owned by farmers having herds of above average size. In most cases the services of these bulls are available to nearby herds for a small fee. The charge commonly varies from $1 to $5 per service, depending on the quality of the bull. It is a common practice for a small group of farmers having small dairy herds to buy a sire to be used cooperatively. Both methods make it possible for individuals to have access to better bulls than would individual ownership.

Although there is a tendency to keep more milk cows on large farms than on small farms, the number kept is not in proportion to the greater acreage. In general, dairying is carried on incidental to the regular farm program. Normally, dairying interferes very little with crop production, because most of the labor connected with the small dairy enterprise is handled as morning and evening chores.

The amount of family labor available on the farm is a factor closely associated with the number of cows milked. Milking, feeding, and other work necessary to care for the dairy herd and dairy products is usually done by members of the family. Little or no outside labor was hired for this work on the farms studied. The dairy enterprise provides profitable use for relatively large amounts of family labor, particularly in the winter when regular farm work is slack. Although labor requirements for dairy cattle usually remain about the same throughout the year, (See Figure 12) the number of cows milked, and labor requirements for the enterprise can be adjusted to some extent during peak labor periods.

The chief competition for labor between dairying and other enterprises occurs during the peak of labor requirements for crop production. Adjusting the time of freshening so that a large proportion of the dairy herd is drying during the peak labor requirements of harvesting will reduce the extent to which dairying competes with crop production for labor. Farmers ordinarily milk fewer cows during the harvesting season than during any other part of the year. Cows that freshen during December and January can be given plenty of attention during the early part of the lactation period, their production is stimulated by spring pasture, and they can be easily turned dry when the harvest rush is at its height.

Because of the large production of feed crops, dairying is not limited by the comparatively small acreage of native grass pasture. Dairy cattle use large amounts of home-grown feeds, particularly forage. Erratic climatic conditions results in varying amounts of poorly headed, immature or weather damaged feed for which there is very little market. Furthermore, it is not uncommon for sand to be blown into bundle feed before it

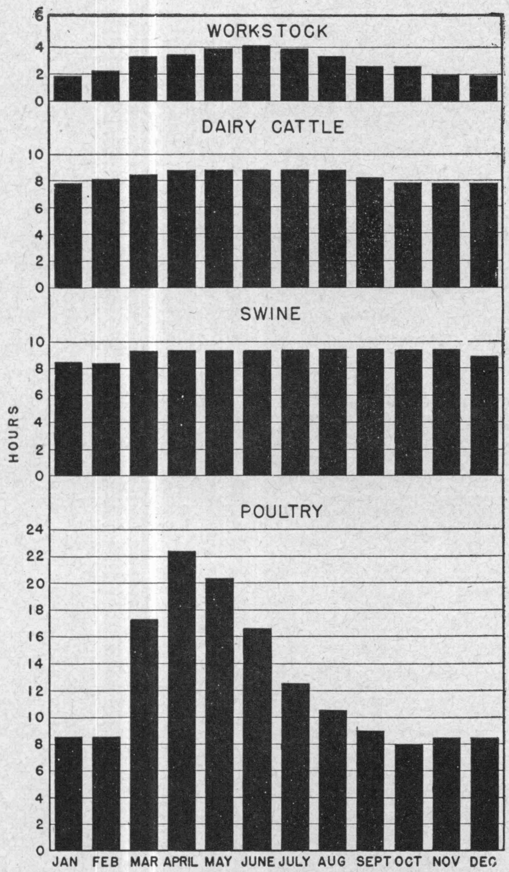

Figure 12. A comparison of the distribution by months of labor requirements for one work animals, one dairy cow, one brood sow and 100 hens.

is stacked. Cattle utilize these unmarketable feeds and dirty forage with less harmful effects than most other classes of livestock. Cattle also utilize the feed value of stalk fields to advantage as well as crops that do not justify harvesting. For the many farms that have disposed of work-stock, dairy cows are a means of utilizing such native pasture as is available. Cows are commonly used to "clean up" after workstock in the feed lot, and in this way considerable grain and forage may be salvaged that would otherwise be wasted. Although milk production may be reduced, the dairy herd can be maintained on forage alone when grain is scarce and high priced.

Grain sorghums and cottonseed made up the bulk of the concentrates fed to dairy cattle. Some cottonseed meal was used at times to assist in balancing the ration. Grain sorghum bundles, particularly cane and Hegari, constitute the principal forage. Sudan provides summer grazing, and will last until frost with favorable moisture conditions. Sudan pasture comprised more than 40 per cent of the total pasture days for dairy cattle. Wheat, native grass, and stalk fields are other important sources of grazing. Wheat usually supplies at least part-time grazing during the winter and spring, and native grass is normally at its best after the time of good wheat pasture and before Sudan is ready to graze. Stalk fields may furnish some fall and winter pasture.

Dairy cattle are commonly fed out of doors. Bundled feed is usually fed on the ground. Grain sorghum heads, the principal source of grain, are also frequently fed on the ground or in poorly constructed troughs. Both methods result in considerable waste. Feeding on the ground is especially wasteful in wet weather when a large part of the feed is trampled under foot, gets dirty and is not eaten. When feed supplies are plentiful the common practice is to put out enough feed so that the livestock will have all they need after allowing for considerable waste. Periods of high feed prices furnish an incentive to adjust feeding practices in an effort to reduce waste and to obtain as near the full benefit of the feed fed as possible. Some farmers have found that by using well-made troughs and bundle racks feed requirements for their dairy cattle can be materially reduced.

Because cattle utilize ground grain sorghum heads more thoroughly than when fed unground, grinding permits more efficient use of that part of the dairy ration. The lower part of the grain sorghum stalk is usually coarse and unpalatable and is not eaten when cattle are well fed. This loss usually occurs regardless of the method of feeding. Here again chopping or grinding will result in more complete utilization of the feed.

It should be kept in mind that ground feed cannot be fed on the ground or in poorly constructed troughs without greater waste than when fed in the head or the bundle. The benefits of grinding may be offset by increased waste in feeding if good feeding equipment is not used. Farmers have also found that ground feed fed in exposed troughs may be wasted by the wind.

Feed that is ground before it is thoroughly dry is very likely to heat and spoil if sacked or stacked in bulk. Feed that is not thoroughly cured will keep much better in the head or in the bundle.

Most farmers depend upon custom hire for feed grinding since they do not have enough livestock to justify the ownership of a feed grinder. It is sometimes possible to have feed ground on the farm with portable equipment. When this service is not available, the feed must be hauled to and from the grinder. The usual charge for custom grinding varies from \$2 to \$3 per ton.

Feed prices, the amount of waste that can be prevented and the amount of time and expense connected with taking the feed to and from the grinder largely determine whether or not it is profitable to grind feed. When feed prices are very low, the ordinary amount of waste will not justify grinding. In 1932 for instance, when milo heads were only worth \$3.00 per ton on the market, the cost of grinding would have been almost as much as the value of the unground feed and was not justified as a general practice. During the feed shortage caused by the 1934 drought, milo heads cost \$30 or more per ton and bundle feed sold for \$18 to \$20 per ton. With such feed prices, farmers considered it very prifitable to grind both heads and bundles. In general the savings through better utilization of feed must more than offset the expense of grinding and of hauling to and from the grinder to make grinding profitable.

The average amounts of feed fed to dairy cattle and the variations in production on farms grouped according to the quantity of concentrates fed are shown in Table 6.

The amount of cottonseed fed ranged from 41 to 57 per cent of the total concentrates fed to the different groups. Cottonseed was relatively less important as the amount of concentrates fed per cow increased. Milo was the most important grain fed. Even though there was some tendency for those who fed most liberally of concentrates to feed heaviest of forage also, the group to group variation in amount of roughage was not nearly so great as was the variation in amounts of concentrates.

Sudan made up more than 40 per cent of the pasture grazed by dairy cattle. The remainder of the grazing was furnished by wheat, native

Table 6. Variations in feed fed and production per cow, 1931-1935, inclusive.

	Pounds concentrates fed per cow			
	Less than 450	451-900	901-1350	Over 1350
Average number of farms	41.0	39.0	25.0	28.0
Cows milked per farm	5.7	5.4	5.8	5.6
Butterfat per cow milked	140.4	177.7	193.0	198.5
Calves per cow	9	.9	.9	.9
Concentrates per cow:				
Milo (threshed) (Pounds)	27.7	127.4	318.9	630.0
Kafir (Pounds)	5.6	15.0	31.3	70.8
Other grains (threshed) (Pounds)	15.3	54.0	82.0	194.8
Cottonseed (Pounds)	124.6	310.1	468.5	722.1
Other proteins (Pounds)	44.0	106.2	111.8	149.6
Total concentrates (Pounds)	217.2	612.7	1,012.5	1,767.3
Roughage per cow:				
Cane bundles (Pounds)	1,341.9	1,709.7	1,366.6	1,614.2
Hegari bundles (Pounds)	1,360.9	1,149.7	1,485.6	1,293.9
Kafir bundles (Pounds)	415.5	375.1	379.1	483.1
Other bundles (Pounds)	357.0	356.3	334.8	410.9
Other roughage (Pounds)	520.2	599.5	560.1	717.1
Total roughage (Pounds)	3,995.5	4,190.3	4,126.2	4,519.2
Pasture days per cow:				
Native	32.4	22.4	26.1	24.2
Sudan	63.2	64.6	76.0	72.4
Wheat	23.4	27.7	34.3	33.6
Other pasture	34.5	36.9	34.2	27.3
Total days pasture	153.5	151.6	170.6	157.5

grass, and stalk fields in about equal proportions. The amount and kind of grazing varies considerably from year to year. Apparently, differences in the amount of available pasture was not the cause of differences in levels of feeding since the heavy grain rations were accompanied by approximately the same number of grazing days as were the light grain rations.

Cows fed less than 450 pounds of concentrates lacked 37 pounds of producing as much butterfat as those which were fed between 450 and 900 pounds of concentrate. Animals in both groups were on pasture about the same number of days, but those in the second group received approximately 400 pounds more concentrates and 200 pounds more roughage. Assuming average prices (1929-1936) for butterfat and feed (See Tables 24 and 25) it appears that farmers who fed between 450 and 900 pounds of concentrates were practicing a more profitable level of feeding than were the groups feeding more or less concentrates. The two groups fed in excess of 900 pounds of concentrates per cow did not produce enough more butterfat to pay for the additional grain. This fact is no doubt largely the result of greater waste of feed on farms where the heaviest feeding was practiced.

For best results feeding practices should vary according to the quality of available roughage. Cows need 2 pounds of dry forage or its equivalent in pasture or silage per hundred pounds of live weight. Good pasture provides the best roughage for dairy cows and is usually cheaper than harvested crops. Herds fed high protein roughages such as alfalfa hay or on good green pasture should be fed 3 to 3½ pounds of home-grown grain per gallon of milk produced. Cows fed low protein forages including sorghum bundles, Sudan hay or silage or on poor pasture should receive a grain feed containing 18 to 20 per cent protein at the rate of 3½ to 3¾ pounds per gallon of milk. A grain mixture of 2½ parts (by weight) of sorghum grains and 1 part of cottonseed meal will contain approximately 20 per cent protein.

According to this standard a cow producing 175 pounds of butterfat will require, in addition to the pasture normally available in the area, approximately the following amounts of concentrates and forage per year.

Grain sorghum grain	**1,500 pounds**
Cottonseed meal	**225 pounds**
Cane bundles or grain sorghum bundles without grain	**3,600 pounds**

Good management practices result in more efficient use of all feeds consumed by the dairy herd. Dairy specialists suggest the following practices for good dairy herd management:

1. **Cull on the basis of production and increase the feed of the good cows. This will increase production and save feed and labor as large amounts of feed are commonly used in feeding unprofitable producers at the expense of the good cows in the herd.**
2. **Maintain good health in the herd.**
3. **Provide plenty of clean water at all times. Dairy cows should have cool water during the hot weather and warm water during cold weather.**
4. **Provide shade during summertime and shelter when the weather is cold.**
5. **Milk cows at regular intervals and as rapidly as possible once the milking operation starts.**

Hogs

Hogs are kept primarily to produce meat and lard for the farm family. Although 90 per cent of the farms studied produced pork, hog sales amounted to only 3 per cent of gross farm receipts. Approximately 60 per cent of the farms with hogs kept brood sows, while the remaining 40 per cent kept no sows but purchased weanling pigs to fatten. Some farmers with brood sows sold weanling pigs, while others made a regular practice of fattening their pigs for market.

One or two sows was the usual-sized breeding herd. Most hog raisers did not keep enough sows to justify owning a boar but depended on using the boar of some neighbor. Breeding fees were usually $1.00 to $2.50 per service or one weanling pig for each litter farrowed. On the farms studied an average of 5.7 pigs per litter were weaned. Ordinarily sows were bred to farrow both a spring and a fall litter.

There were not many registered or purebred hogs in the area, but, in general, good grade and thrifty animals were predominant.

Although there was some tendency to have more hogs on large farms than on small farms, the enterprise was not proportionately larger. As a general rule, hogs are not maintained in sufficient numbers to affect the cropping system of the farm.

Farmers in this area have relatively low investments in shelter for hogs. Simple arrangements for protection from sun and from inclement weather is all that is needed. Although round worms are present and occasionally cholera has been reported, hog diseases and parasites have not seriously handicapped hog producers. As a result, farmers have not found it necessary to take many sanitary precautions. Expansion of the hog enterprise would warrant more attention to vaccination against cholera and other diseases and systems of sanitation for the control of parasites and diseases.

The labor required per 1,000 pounds of pork produced (See Figure 12) is relatively large on the farms studied. This is partly due to the small size of the enterprise in most cases. Little effort has been made to provide labor saving equipment such as self-feeders or running water in hog lots when only a few hogs are kept. The usual methods of hand-feeding and watering are time-consuming. It would be possible to effect considerable savings in labor requirements for pork production by effecting a few changes in management.

Farmers with only a few hogs most commonly feed grain sorghums in the form of heads, while those with a larger hog enterprise are more likely to feed threshed grain. Threshed grain fed in self-feeders results in very little waste and is generally considered the most efficient method of feeding grain sorghums to hogs. Sorghum heads are normally hand-fed, usually on the ground. Heavy feeding of heads frequently results in considerable waste, particularly when fed on dusty or muddy ground. The use of concrete or wooden feeding floors reduces waste when heads are fed but is not as efficient a feeding practice as threshed grain fed through a self-feeder. It is not a common practice to grind feed for hogs. Farmers who raise hogs only for meat or raise only one or two litters of pigs per year usually do not buy tankage, cottonseed meal, or commercial protein supplements to balance the hog ration, but depend on skim milk. When the milk supply is not adequate, it is profitable to use tankage, cottonseed meal, or some other protein rich feed in the ration.

The difficulties encountered in maintaining hog-proof fences discourages the use of hog pastures. Soil accumulations tend to cover this type of fence. A large amount of work is required to keep such accumulations worked down and the fence depreciates rapidly if the accumulations are allowed to remain.

Feed requirements for pork production on farms keeping brood sows and on farms without brood sows are shown in Table 7. Farms without brood sows produced an average of 835 pounds of pork. This amount was only 100 pounds greater than the average poundage used in the home. Farms with brood sows weaned an average of 18 pigs and produced 2,956 pounds of pork. These farms fed 511 pounds of concentrates to produce 100 pounds of pork, while farms without brood sows produced an equal weight of pork by feeding 628 pounds of concentrates. Greater waste in feeding largely accounts for the larger amounts of concentrates fed per

Table 7. Feed requirements for the production of pork, 1931-1935, inclusive.

Items	Farms having Feeder pigs	Brood sows
Number of farm records	246	383
Pork produced per farm	835.5	2956.1
Litters per farm	—	3.1
Pigs weaned per litter	—	5.7
Concentrates per 100 lbs. pork (live weight):		
Milo	350.6	249.7
Kafir	26.9	62.7
Hegari	28.7	12.4
Corn	185.9	150.1
Protein feeds	5.1	7.2
Other concentrates	31.1	29.1
Total concentrates	628.3	511.2
Skim milk	641.7	384.3
Pasture days:		
Sudan	.01	.69
Other	.02	.54
Total pasture	.03	1.23

100 pounds of gain with feeder pigs than was fed for production by farmers with brood sows. Many of the farms which kept no brood sows did not buy feeder pigs until the new feed crop was mature. These hogs went on feed so late that wasteful feeding practices were followed in an effort to get the animals fat by killing time.

Grain sorghums made up approximatey two-thirds of the total concentrates fed to hogs. Corn was the second most important grain fed and was used primarily to finish meat hogs. Very little protein-rich feeds, such as tankage or cottonseed meal were given hogs. On farms without brood sows, approximately 75 gallons of skim milk were fed for each 100 pounds of pork produced. Hogs on the farms that kept brood sows were given about 45 gallons of skim milk per 100 pounds of pork produced. Sudan constituted better than half of the pasture used by hogs. In general, only farms having brood sows used pasture for pork production and these to only a small extent.

The relatively large amounts of grain fed by cooperating farmers per 100 pounds of gain indicate an opportunity to lower costs by more efficient management of the enterprise. Under favorable conditions and skilled management, 100 pounds of pork (live weight) can be produced on feeder pigs with about 350 pounds of sorghum grain plus protein and mineral supplement. When the feed required to maintain brood sows are figured in, 100 pounds of live pork can be produced with approximately 425 pounds of grain in addition to protein and mineral supplements. In order to obtain such a high level of feeding efficiency, several phases of swine management need careful consideration.

1. It is necessary that feeder pigs be of the type and breeding capable of making efficient use of feed.

2. Careful attention should be given to sanitation and to disease control. Best results are obtained when young pigs are not permitted to become infested with internal or external parasites and are kept free of disease. A large number of the common swine parasites and diseases are carried over from year to year in houses and old yards in which hogs are

kept continuously. These parasites and diseases can be controlled by sanitation. To do this farrowing pens should be located on "clean ground" where no hogs have run for at least one year. Before being moved to clean ground, farrowing quarters should be cleaned and disinfected to destroy worm eggs and disease germs. Washing the sides and udder of the sow with soap and water before she is put in a clean farrowing pen will remove worm eggs from the sow. Pigs should be confined to clean pasture until they are at least four months old. Feeder pigs should be treated for worms before they are placed on feed. When pigs are seen scratching or rubbing against posts or fences they should be treated for lice or mange.

3. Feeding methods and the feeds used are important. Grains are deficient in protein and minerals and a protein supplement and mineral mixture should be fed for best results. Practically all farm grains and mill feeds are deficient in Vitamin A. This deficiency is amply supplied by green pasture. Experiment Station tests and the experience of farmers have shown that good results may be obtained with sorghum grains when properly fed.

It has been shown[8] that pigs make as fast and as economical gains when fed whole milo or whole kafir in self-feeders, as they will when fed ground milo or kafir. Self-fed pigs make better use of threshed sorghum grains than do hand-fed pigs. When fattening pigs are fed whole sorghums by hand twice daily, the pigs eat faster, eat more greedily, and consequently swallow larger amounts of grain before masticating it than they do when self-fed.

4. Green pasture is necessary for pigs from birth until they weigh about 100 pounds, if they are to grow and fatten most efficiently.[9] If pasture is not available, some choice alfalfa meal should be included in the protein supplement, or green alfalfa hay may be self-fed in racks.

5. The general management and care given hogs affect the rate and efficiency of gain. The feed in the self-feeder must be kept clean and fresh for best results. Pigs are inclined to eat too much protein supplement when the grain is dirty and unpalatable. Fresh grain should be put in the self-feeder every three or four days. In order to get the most efficient gains it is important to keep hogs as comfortable as possible. Plenty of shade and quarters free from dust are necessary for summer feeding. In winter the sleeping quarters should be dry and free from cold draughts.

Poultry

Chickens, the principal type of poultry, are produced on practically every farm. The farms studied averaged approximately 100 hens. Poultry and egg sales amounted to 5 per cent of the cash receipts for these farms. Poultry was kept largely for egg production with meat production being incidental or secondary. Broilers and fryers were not commonly raised for market, but surpluses not needed for home use were sold. Cull hens made up the bulk of the poultry marketed.

[8]Progress Report No. 634, Texas Agricultural Experiment Station, Preparation of Farm Grains for Fattening Hogs.
[9]Progress Report No. 631, Texas Agricultural Experiment Station, Market Farm Grains as Pork at Better Prices.

The farm flocks of the area are usually purebred rather than mixed or crossbred. Farmers stressing egg production usually keep Leghorn hens, while those who wish to have heavier birds for table use and the market keep medium weight breeds such as Rhode Island Red or Barred Plymouth Rock.

The number of chicks hatched or purchased usually depended on the number of pullets needed for flock replacement. It is usually necessary to start with approximately 125 chicks each year to provide the pullets needed to maintain a flock of 100 hens. On the farms studied, about 25 per cent of the baby chicks died before reaching the age of three months. Approximately 60 per cent of the chicks raised were obtained from the hatcheries. Farmers either had their own eggs custom hatched or bought baby chicks. This practice permits the brooding of all baby chicks at one time which is considered good poultry management. During the period of study costs of custom hatching varied from one and one-half cents to three cents per egg, and baby chick prices varied from five cents per chick on up depending on the breed and quality.

All flocks that supply hatching eggs to the hatcheries are required to have their flocks blood tested for white diarrhea and coccidiosis and to dispose of all birds that react positively to the test.

Although climatic conditions are conducive to the production of high quality eggs, the marketing system has offered little in the way of premiums for infertile and high quality eggs. As a result producers have made little effort to improve the quality of eggs marketed.

The poultry enterprise fits in nicely with the usual farm organization, because the enterprise can be handled so that it interferes very little with other phases of the business. During the time of year that the operator is busiest with crop production, chickens require a relatively small amount of attention. The labor peak with chickens on the farms studied was during March, April, May, and June when chicks were small and needed extra attention. (See Figure 12.) Small chicks require considerable extra attention until they are approximately two months old. By having March hatched chicks, farmers can have the peak labor period for poultry largely out of the way before crop planting gets under way. Previous to crop planting, the operator usually has spare time that can be used to an advantage with poultry. Aside from the peak labor requirements during the brooding period, the farm poultry flock is cared for largely by the farmer's wife and children.

On many farms a small or average size flock of chickens can be largely maintained on grains wasted by other kinds of livestock or shattered in the handling of heads or bundle grain sorghums. Some grain will be shattered no matter how carefully the heads or bundles are handled. Chickens are particularly useful in picking up loose grain in stack lots because they cannot tear down or seriously damage stacked feed.

Because they require a concentrated ration chickens provide an important outlet for the sorghum grains grown in the area. Milo, kafir, and Hegari grain made up approximately two-thirds of the average poultry ration on the farms studied.

Farm flocks were commonly fed some mash or ground feed in addition to the home-grown grains. The mash is generally a commercially mixed product, however, some farmers mix their own, using home-grown grains supplemented with protein supplements and mill feeds. It was a common practice to buy commercially mixed starter mash for baby chicks. This was usually fed in connection with home-grown grains. After chicks were well started, a majority of growers fed a growing mash along with whole grain. Others discontinued the use of mash feeds and used home-grown grains entirely as soon as the chicks were well started. Skim milk was included in the poultry ration when available. Mash feeds were usually fed dry in self-feeders while grain was fed on the ground or in litter.

Data in Table 8 are the average quantities of feed fed per 100 hens and the average production per hen on farms grouped according to the amount of concentrates fed. Forty-six farms fed an average of only 610

Table 8. Variations in feed fed per 100 hens and production per hen, 1931-1935, inclusive.

Items	Pounds of concentrates per 100 hens			
	Less than 1,200	1,201-2,400	2,401-3,600	Over 3,600
No. farms reporting poultry	46	34	19	35
Hens per farm (Number)	81	104	106	132
Total eggs per hen (Number)	76	84	92	128
Concentrates fed per 100 hens:				
Milo (Pounds)	333	1,021	1,473	2,651
Kafir (Pounds)	27	88	89	205
Hegari (Pounds)	25	44	156	242
Corn (Pounds)	55	122	198	332
Other grain (Pounds)	61	126	329	462
Total grain (Pounds)	501	1,401	2,245	3.892
Mixed poultry feed (Pounds)	36	166	308	985
Mixed chick feed (Pounds)	49	95	133	230
Cottonseed meal (Pounds)	2	1	7	12
Tankage and meat scrap (Pounds)	4	3	16	44
Other concentrates (Pounds)	18	52	67	254
Total concentrates (Pounds)	610	1,718	2,776	5,417
Skim milk (Pounds)	3,898	4,016	4,144	3,956
Minerals (Pounds)	2	3	8	33

pounds of concentrates per 100 hens per year. The fact that an average of 76 eggs per hen was obtained with such a low level of feeding suggests that these flocks depended on waste grain to a large extent. Liberal feeding was more common with large flocks than with small flocks and indicates that the latter depended more on waste grain than did the large flocks.

As the amount of concentrates fed per hen increased, egg production per hen increased. Thirty-five farmers fed an average of over 5,400 pounds of grain per 100 hens per year. It seems reasonable to expect that waste grain made up a very small part of the feed consumed by flocks with such a high level of feeding.

The mixed poultry feeds listed in Table 8 were made up almost entirely of commercial laying mash which varied from 6 to 19 per cent of the total concentrates for the groupings shown. The use of laying mash tended to increase with liberal feeding practices. Minerals, such as oyster shell, bone meal and salt, were relatively unimportant except for the group of farms practicing the most liberal feeding.

According to poultry specialists, the ration of laying hens should contain about 15 per cent protein. Such a ration may be obtained by feeding equal parts of home-grown grains and a mash containing 18 per cent protein. Those who have grains to market through poultry may well use a 30 to 34 per cent protein supplement. One pound of 30 per cent protein supplement fed with 2½ pounds of grain or one pound of 34 per cent protein supplement and ½ pound of wheat gray shorts and wheat bran fed with 3 pounds of grain provides a satisfactory ration for laying hens.

The amount of concentrated protein feeds needed for poultry may be reduced somewhat by use of succulent green feed. Pasture from oats, wheat, or barley in winter and spring and Bermuda and Sudan grass in summer supplies proteins and vitamins needed by poultry. Skim milk can replace up to 75 per cent of the proteins needed to balance home-grown grains if it is regularly available and enough can be supplied to furnish all of the liquids the birds require.

Other Livestock Enterprises

Cattle and lamb feeding has been used to some extent as a means of utilizing feed surpluses. This type of enterprise is flexible and can be rapidly expanded during periods of large feed supplies or can be abandoned when conditions are unfavorable. Up to the present time, most of the feeding in the area has been done by commercial feeders rather than farmers. These feeders operate on a large scale, maintain well-equipped feeding plants, and employ experienced men. They buy feed from the farmers and use large quantities of both forage and grain. The operation of such feeders has tended to strengthen feed prices in the area.

There are several factors that have tended to retard the expansion of cattle and lamb feeding among farmers. Farmers of the area lack experience as feeders and also lack equipment for feeding cattle or sheep. Additional capital would be required to purchase feeders and get the necessary equipment.

A feeding enterprise is most desirable from the standpoint of feed supplies, and often from the standpoint of price relationships, immediately following the production of a big feed crop. Feeding must be done during the winter and spring or it competes with crop production for labor. As a rule, when the feed crop is large, the cotton crop is also large. Harvesting these crops may fully occupy the available labor until early spring and leave no time to devote to a livestock feeding project.

As a rule, farmers cannot feed many animals at a time and have difficulty in buying a small number of feeders. Ranchmen prefer to sell to one buyer rather than to a large number of buyers and consequently hesitate to permit any one to buy a few head. The farmer who buys a carload of feeders can get them on the market, but the feeder who only wants a few head often has difficulty locating what he wants.

Normal Production and Requirements of Livestock

The normal production and requirements of livestock are shown in Table 9. These data are based on the results obtained on the farms studied during the 5-year period 1931-1935.

Generally speaking, the workstock kept on the farms were good draft animals capable of pulling large machinery. Horses and mules were kept

Table 9. Normal production and usual requirements of livestock.

	One work animal	One milk cow	One sow	100 chicken hens	One beef calf[1]
Contribution to farm operation and income	630 hrs.	250 lbs. beef 175 lbs. b. fat	2,400 lbs. pork	820 doz. eggs 80 lbs. fryers 150 lbs. hens	300 lbs. beef
Production or maintenance requirements:					
Man labor (Hours)	35	100	110.	150	10
Feed:					
Concentrates					
Grain sorghums (Lbs.)	2,200	400	8,640	1,900	1,800
Other grain (Lbs.)			3,600	250	
Cottonseed (Lbs.)		400			
Protein feeds (Lbs.)		150	240	25	300
Mixed feeds (Lbs.)				600	
Skim milk (Lbs.)			10,400	4,000	
Roughage					
Cane bundles (Lbs.)	900	2,400	—	—	1,350
Other sorghum bundles (Lbs.)	5,200	3,200	—	—	
Acres in pasture					
Sudan	.8	1.25	—	—	
Native grass	2.0	3.75	—	—	
Small grains	.3	1.40	—	—	
Miscellaneous cash costs	1.00	2.50	1.50	10.00[2]	1.00

[1]Requirement data for beef calf based on estimates supplied by livestock specialists.
[2]Includes cost of baby chicks.

in the ratio of about 5 horses to 4 mules. Workstock were used an average of 630 hours per head per year on the cooperating farms. The hours worked per head of workstock varied a great deal from farm to farm and were reflected in the amount of feed required. Workstock used a small number of days per year are on pasture a higher percentage of the time and consequently need less feed than do work animals used a large number of days. The amounts of feed fed to stock could be reduced on many farms by less wasteful feeding practices.

The average cow on the farms studied produced 175 pounds of butterfat during a milking period of approximately ten months. Wide variations were noted in the annual butterfat production of cows on different farms. Production per cow is an important factor affecting profits. A high producing cow requires very little, if any, more feed for maintenance than does a low producing cow and consequently uses a much larger part of the feed received for the production of milk and butterfat. As the production per cow increases there is a strong tendency for the net income per cow to increase.

Dairy cows often receive enough feed, but frequently it is not the right kind to fill the requirements of high producing animals. When made up entirely of grain sorghum grain and forage, the dairy ration is low in protein and should be balanced by the addition of a high protein feed such as cottonseed meal for best results. Because of the lack of a legume hay dependence must be placed on high protein concentrates to balance the dairy cow ration. Cottonseed is fairly high in protein and is fed on many farms. Generally the price relationships which exist between cottonseed and cottonseed meal, make it more profitable to sell the seed and purchase meal. However, when cottonseed prices are very low, it is usually more profitable to feed cottonseed.

The production requirements for hogs as shown in Table 9 are for an enterprise unit of one sow producing two litters during the year. More rapid gains and a reduction in the feed requirements for pork production could be obtained by more liberal feeding of protein rich feeds such as skim milk, tankage, or cottonseed meal. Many farmers have sufficient skim milk to balance the ration for a few meat hogs, but an expansion of the swine enterprise should be accompanied by heavier feeding of high protein feeds.

The normal production and requirements for chickens are shown in Table 9. These farms kept an average of approximately 100 hens and obtained an annual egg production of nearly 100 eggs per hen. Since poultry depends on waste grain for part of their feed, any large increase in size of flock would be expected to result in more liberal feeding practices. Liberal use of farm-grown grains does not necessarily mean that a balanced ration is fed because these feeds alone do not contain sufficient protein to make a well-balanced poultry feed. The poultry ration on many farms would be better balanced by including a large proportion of feeds high in protein such as meat scrap or cottonseed meal. Good results have been obtained when plenty of skim milk was available to supplement the common farm feeds.

FACTORS AFFECTING THE CHOICE OF FARM POWER

A wide range in size of machinery and type of power is available to farm operators in the High Plains Cotton Area. This has resulted from relatively recent developments in the power and machinery field. The available power and machinery range from one-row horse-drawn to four-row tractor-drawn units. The land resources of the area are such as to encourage or facilitate the adoption of multi-row machinery and large power units. A review of what has taken place in the power and equipment used on the farms studied will serve to indicate the manner in which farmers have reacted to the available alternatives and to new developments in power and equipment.

The early development of farming in the area was based largely on the use of one-row horse-drawn equipment brought by settlers from the older agricultural sections to the east. A study of the cost of producing cotton on 54 farms, selected at random in the area, revealed that as late as 1923 one-row equipment, only, was being used on these farms.

Tractors available previous to 1925 were designed primarily for belt work and for flat-breaking, discing, and harrowing, operations not generally practiced in the area. Therefore, tractors were useful on individual farms only during that short period of time when sod was being broken. This work was usually done on a custom basis by means of large road-type tractors. By 1925 a tractor especially designed to plant and cultivate row crops was developed. The new tractors proved to be particularly well adapted to the needs of cotton producers, and a number of them were employed in the High Plains Cotton Area in 1926. Almost simultaneously with the introduction of the all-purpose type tractor came the use of two-row horse-drawn lister-planters and cultivators and of the cotton sled or stripper in harvesting cotton. Thus, 1926 marks the approximate date of the introduction of large-scale methods of cotton production in the High Plains Cotton Area.

By 1931 farmers in this area were well along in the shift from one-row equipment to multi-row equipment. A study of 141 farms showed that only 9 of these farms depended entirely upon and had but one set of single-row equipment, (See Table 10) while 35 others used one-row horse-drawn machinery supplemented by some two-row equipment, usually a cultivator. Sixty-one farms were using at least one complete set of two-row horse-drawn equipment, although 17 of these used some single-row machinery in addition. Of the remaining 36 farms, 20 used only two-row tractor-

Table 10. Changes in size of equipment and power units March 1, 1931 to March 1, 1937 and acreage of crop land on farms using each size of equipment in 1936.

Item	Year							Crop land per farm during 1936
	1931	1932	1933	1934	1935	1936	1937	
Total number of farms	141	138	127	139	138	126	126	(Acres)
Farms using one-row horse-drawn equipment	9	7	7	5	5	7	4	98
Farms using one-row and two-row horse-drawn equipment	35	33	24	16	12	5	5	145
Farms using one set of two-row horse-drawn equipment	40	36	45	60	42	32	16	182
Farms using two-row plus one-row horse-drawn equipment	17	27	21	16	11	5	2	245
Farms using two sets of two-row horse-drawn equipment	4	5	4	8	4	2	—	380
Farms using two-row tractor-drawn equipment (one tractor)	20	19	12	18	46	52	74	233
Farms using two-row tractor and one-row horse-drawn equipment	6	6	7	7	3	4	4	310
Farms using two-row tractor and one set of two-row horse-drawn equipment	9	3	5	5	7	7	4	408
Farms using two-row tractor and two sets of two-row horse-drawn equipment	1	1	1	—	—	2	1	600
Farms using two-row tractor-drawn equipment (more than one tractor)	—	1	1	—	—	1	2	418
Farms using three- four-row tractor-drawn equipment	—	—	—	3	5	7	12	408
Farms using three- four-row tractor and one-row horse-drawn equipment	—	—	—	1	2	2	2	387
Percentage of farms using two-row equipment for bulk field work	68.8	69.5	75.5	82.0	82.0	83.3	84.1	
Farms using three- four-row tractor and two-row horse-drawn equipment	—	—	—	—	1	—	—	—
Percentage of farms using only two-row or larger equipment	52.5	47.1	53.5	67.6	76.1	81.0	86.5	
Percentage of farms having tractors	25.5	21.7	20.5	24.5	46.4	59.5	78.6	
Average number of workstock per farm	6.2	6.2	6.4	5.9	4.6	3.5	2.7	

drawn equipment, while 16 farms supplemented two-row tractor equipment with some horse-drawn machinery. All the tractors were of the all-purpose type.

The changes in size of equipment and power units that have taken place between March 1, 1931 and March 1, 1937 are shown in Table 10. Between 1931 and 1934, there was a substantial increase each year in the use of two-row horse-drawn equipment. The number of farms depending largely upon one-row equipment declined from 31 to 15 per cent during the period, while those depending upon two-row horse-drawn equipment rose from 43 to 60 per cent of all farms. Farms using only two-row or larger machinery, regardless of type of power used, also increased from 52 to almost 68 per cent.

After 1934 the shift from horsepower to tractorpower took place rapidly. The proportion of farms using tractorpower increased from 24 to 46 per cent between 1934 and 1935. The shift continued through 1936 and 1937. By 1937, 78 per cent of all cooperating farmers had tractors and 68 per cent used tractors for all field operations involving machinery, with the exception of feed harvest. Since 1934, the shift to larger field machinery kept pace with the shift from horsepower to tractorpower. The trend toward larger power units, even in the case of tractors, is indicated by the fact that in 1937 the number of four-row tractor outfits had increased to 14 as compared to only four in 1934. By 1936, 86 per cent of all cooperating farms were using only two-row or larger equipment as compared to 67 per cent in 1934 and 52 per cent in 1931. The major changes in the sizes of field machinery since 1934 have been a continuation of the decline in the number of farms using four-row equipment. A comparison of the per acre cost for power and equipment on farms using horsepower with farms using tractorpower is shown in Table 11. Relatively low feed prices during 1931,

Table 11. Power and equipment costs on farms, 1931-1935.

	1931	1932	1933	1934	1935
Farms with tractors..................(Per cent)	25.5	21.7	20.5	24.5	46.4
Power and equipment cost per acre of cropland:					
All farms..........................(Dollars)	2.39	1.72	1.96	2.59	2.88
Farms with tractors...............(Dollars)	2.48	1.95	2.13	2.06	2.75
Farms without tractors............(Dollars)	2.35	1.61	1.90	2.84	3.03

1932, and 1933 were favorable to horsepower and influenced the tendency of farmers to standardize on two-row horse-drawn equipment. This tendency was also affected by the lack of purchasing power of farmers during the depression years. In 1935, the credit situation eased so that a large proportion of farmers were able to purchase tractors. Feed prices also became relatively high because of crop failure and low yields obtained in 1934. Prices of workstock increased rapidly. The result was a substantial increase in the cost of power and equipment on farms using workstock while the cost of tractorpower changed but little.

During the years of the study there has been a rapid increase in the proportions of farms using but one set of equipment. In 1931, about half did so, but in 1937, 84 per cent used but one set of equipment. Seventy per cent of these were two-row tractor-drawn; 11 per cent were four-row tractor-drawn; 15 per cent were two-row horse-drawn; and only 4 per cent were one-row horse-drawn. Thus, it seems that farmers generally are choosing a size of power unit to permit one-man operation of the land under their control. The wide range in the size of power units that are available, together with improved equipment has made it possible for most farmers to select a unit of power which is adapted to the size of farm operated.

Table 12. Quantity and value of feed fed per head of workstock on farms studied, 1931-1935.

	1931		1932		1933		1934		1935		Five-year average	
Number of farms with horses	132		128		119		34		17		86	
Number of horses per farm	7		7		7		6		7		7	
Feed fed per head of workstock:	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
Grain and other concentrates:												
Milo	1,830	13.15	2,638	7.55	2,258	8.44	1,484	15.80	1,206	18.33	1,883	12.65
Kafir	35	.18	180	.46	276	1.02	105	.82	12	.19	121	.53
Hegari	45	.37	50	.16	92	.36	143	1.32	15	.31	69	.50
Corn	21	.21	35	.10	70	.28	17	.31	70	1.33	43	.45
Other concentrates	38	.32	18	.05	—	—	61	1.16	191	3.30	62	.97
Total grain and concentrates	1,969	14.23	2,921	8.32	2,696	10.10	1,810	19.41	1,494	23.46	2,178	15.10
Bundle feed with grain:												
Hegari	3,245	9.96	3,061	4.66	3,409	6.35	4,133	13.70	3,053	14.71	3,380	9.88
Kafir	583	1.62	1,442	2.26	1,608	2.69	1,605	4.64	679	3.59	1,183	2.96
Cane	433	.89	790	1.08	1,426	2.57	935	2.97	265	.58	770	1.62
Sudan	81	.16	55	.11	40	.10	7	.03	83	.14	53	.11
Miscellaneous	748	2.67	809	1.29	882	1.54	835	3.49	530	5.28	761	2.85
Total bundle feed	5,090	15.30	6,157	9.40	7,365	13.25	7,515	24.83	4,610	24.30	6,147	17.42
Headed bundles and straw	223	.69	259	.25	127	.22	750	4.01	752	5.70	422	2.17
Pasture days:	Days	Dollars	Days	Dollars	Days	Dollars	Days	Dollars	Days	Dollars	Days	Dollars
Native	34	1.13	22	.33	16	.25	4	.10	17	.43	19	.45
Sudan	65	2.17	94	1.41	52	.78	20	.43	97	1.74	65	1.31
Wheat	29	.96	30	.60	8	.15	17	.50	5	.16	18	.47
Other	29	.95	33	.50	22	.35	56	1.74	39	.66	36	.84
Total pasture days	157	5.22	179	2.84	98	1.53	97	2.77	158	2.99	138	3.07
Total value all feed		35.44		20.81		25.10		51.02		56.45		37.76

Farmers in the area continue to be confronted with the problem of making adjustments in farm power. Consideration should be given to a number of points before changes in power and equipment are made. It is desirable to know the input of materials as well as the cost involved per day's work for the alternative units of power. It is important to select power units that are ample in size for the acreage involved yet care should be taken to avoid the unnecessary expense of maintaining a unit of power which is much larger than required. Since the land available to the majority of farmers at any given time is more or less fixed, the problem is largely one of selecting the power and equipment unit best suited to a particular crop acreage. The cost involved should be considered before making changes in power and equipment. The ability of the individual to finance these changes is a problem that should also be considered.

The following discussion enumerates the cost of each type of power for the farms studied and evaluates the factors which may affect the choice of power.

Amounts of Feed Fed to Workstock

The average amounts of the various kinds of feed fed per head of workstock are shown in Table 12. During the 5-year period, an average of 2,178 pounds of grain, 6,147 pounds of bundle feed containing grain, and 422 pounds of headed bundles of forage were fed per head of workstock. The above amounts were in addition to 138 days on pasture. The less-than-

Table 13. Quantities of feed fed per work animal grouped according to number of days worked per horse per year, average 1931-1935.

Feed fed per head of workstock	Days worked per horse per year		
	71 days and over	56-70 days	Less than 56 days
Concentrates fed:			
Milo .... (Threshed)	2,450.3	2,137.9	1,832.0
Kafir .... (Threshed)	265.9	90.1	92.2
Hegari .... (Threshed)	34.5	89.3	74.6
Corn .... (Threshed)	41.2	25.9	54.5
Other concentrates	19.6	30.3	38.8
Total concentrates	2,811.5	2,373.5	2,092.1
Roughage fed:			
Cane bundles	854.4	977.1	739.2
Hegari bundles	3,442.7	3,215.9	3,211.9
Kafir bundles	1,253.9	1,263.0	1,113.7
Sudan bundles	43.7	82.0	45.5
Other bundles	1,033.6	832.3	541.5
Other roughages	258.3	266.4	273.7
Total	6,886.6	6,636.7	5,925.5
Pasture days:			
Native	12.5	29.1	26.8
Sudan	76.2	70.3	58.1
Wheat	20.9	21.4	21.0
Other pasture	26.5	32.3	32.7
Total pasture	136.1	153.1	138.6
Days worked per horse per year..	84	63	47
Feed cost per day of horse work..	.34	.51	.65

average amounts of both grain and bundles fed in 1931 was partly the result of the scarcity of feed in the area during the first half of the year and the accompanying high feed prices. An additional factor was the almost ideal weather conditions which permitted crop land preparation, planting, and cultivation with a minimum amount of field work. Large amounts of bundle feed were fed workstock in 1933. A large feed supply carried over from 1932 permitted liberal feeding to make up for the lack of spring and early summer pasture.

The drought of 1934 resulted in a shortage of feed, particularly of grain, and in very high feed prices. It naturally followed that farmers in the area fed less liberally under such conditions.

Sudan grass pasture made up almost half of the total pasture days charged to workstock during the study. Because of favorable climatic conditions and above normal acreages, winter wheat furnished a large amount of pasture for workstock in both 1931 and 1932. Owing to the large amount of grazing obtained from wheat pasture, many farmers in the area were able to put in their crops without feed purchases in 1931 despite the prevailing feed shortage.

The changes in feed costs per work animal from year to year also re-

Table 14. Cost of maintaining workstock and total cost per day of horse work, 1931-1935.

Items	1931	1932	1933	1934	1935	5-year average
Number of farms included	132	128	119	34	17	86
Number of horses per farm	7	7	7	6	7	7
Average investment per horse	63.20	61.85	67.00	76.80	93.35	72.84
Average number days worked per horse per year	61	69	64	52	69	63
Feed costs per animal:	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Grain—Home grown	12.30	8.19	9.88	15.17	15.98	12.30
Purchased	1.93	.13	.22	4.24	7.48	2.80
Bundle feed—Home grown	14.93	9.24	12.72	21.37	22.29	16.11
Purchased	.37	.16	.54	3.46	2.01	1.31
Straw—Home grown	.62	.25	.22	2.09	1.45	.92
Purchased	.07	—	—	1.92	4.25	1.25
Pasture	5.22	2.84	1.52	2.77	2.99	3.07
Total feed costs	35.44	20.81	25.10	51.02	56.45	37.76
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Per cent purchased feed was of total feed cost	6.7	1.4	3.0	18.9	24.3	14.2
Other costs per work animal:	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Labor[1]	3.60	3.30	4.29	.44	3.96	3.92
Veterinary expense	.08	.05	.10	.26	.08	.11
Interest	3.79	3.71	4.02	4.61	5.72	4.37
Depreciation	7.90	7.73	8.38	9.60	11.92	9.11
Shelter, water, etc.	9.31	7.61	10.85	9.27	13.21	10.05
Taxes	.60	.47	.41	.41	.45	.47
Total other costs	25.28	22.87	28.05	28.59	35.34	28.03
Total cost per work animal	60.72	43.68	53.15	79.61	91.79	65.79
Total cost per day's work per work animal	.99	.63	.83	1.53	1.33	1.04

[1]Thirty hours of man labor in 1931, 33 hours in 1932, 39 hours in 1933, 37 hours in 1934, and 33 hours in 1935.

flect variations in feed prices. For instance, workstock, on the average, received less concentrates, less forage, and less days of pasture in 1935 than during any of the other years shown, yet 1935 feed costs were the highest of the 5-year period.

The influence of the amount of work done per work animal on the amounts of feed fed and on feed costs per day's work is shown in Table 13. Workstock costs were high on some farms because more animals were kept than were needed to do the work on the farms. Animals working a large number of days received more feed but the feed cost per day of work was lower than for animals working a small number of days. At prevailing prices, workstock used an average of 84 days were fed at a cost (including pasture) of 34 cents per day of work, whereas workstock used an average of 63 days and 47 days were fed at a cost per day of 51 cents and 65 cents, respectively.

Cost of Horse Work

The cost of feeding and maintaining workstock on the farms during the period 1931-1935 is shown in Table 14. The average cost of maintaining a work animal a year on the farms studied, varied from $43.68 in 1932 to $91.79 in 1935. These variations are largely the result of year to year variations in feed prices. There were also differences in the amount of feed fed to workstock one year with another. The periods of light feeding tends to coincide with periods of high feed prices and partially offset the effect that price changes have on the cost of maintaining workstock.

In general, most of the feed fed to workstock was home raised. The amount of feed purchased for workstock varied inversely with the supply of home raised feed on the farms of the area. Purchased feed made up less than 1.5 per cent of the total feed costs in 1932, when feed was plentiful, as compared to nearly 25 per cent in 1935, following the 1934 drought.

Other costs of maintaining workstock, including labor, veterinary expense, interest on investment, depreciation, shelter, water, and taxes are more stable from year to year than feed costs. These other costs made up an average of better than 40 per cent of the total cost of maintaining workstock during the 5-year period.

Six head of workstock are normally kept to operate a farm with a single set of two-row equipment. Using the average cost shown in Table 14, the total cost of maintaining this number of work animals in 1932 when costs were unusually low because of low feed prices, would average approximately $262 and would be $551 in 1935 when feed prices were abnormally high.

Cost of Tractor Work

The costs of operating two-row and four-row tractors are given in Tables 15 and 16. The figures for two-row tractors are for the 5-year period 1931-1935. Very few four-row tractors were used in the area previous to 1934, hence cost figures are available only for 1934 and 1935.

Gasoline, kerosene, and distillate were the fuels used. The average amount of these fuels used in each year of the study are also included. Gasoline made up the greater part of the fuel used by both two-row and four-row tractors. There was a tendency for farmers to increase the use of distillate. Kerosene was used very little for four-row tractors while its use by two-row tractors showed a downward trend.

Tractor repairs averaged $26.55 per year for two-row tractors during the 5-year period. Two-row tractors varied a great deal as to age so that the repair costs shown should be about normal. Repairs for four-row tractors averaged $28.83 for 1934 and 1935. It should be remembered that these were relatively new machines. The fact that most farmers did their

Table 15. Cost of two-row tractor work per farm and per day's work, 1931, 1932, 1933, 1934, 1935, and five-year average.

	1931		1932		1933		1934		1935		Five-year average	
Acres in all crops		309.2		339.1		283.3		217.1		246.1		279.0
Acres in cotton		140.3		164.7		82.9		82.4		79.5		110.0
No. farms with tractors		36		30		26		28		53		35
No. of tractors		37		32		28		28		53		36
Average value per tractor		562		442		377		440		662		497
Days worked per tractor per year		45		52		50		41		65		51
Fuel:	Amt.	Value	Amt.	Value	Amt.	Value	Amt.	Value	Amt.	Value	Amt.	Value
Gasoline (Gallons)	821	$ 82.47	596	$ 54.67	478	$ 46.58	748	$ 64.62	997	$ 84.58	728	$ 66.59
Kerosene (Gallons)	182	12.78	334	23.44	157	9.65	114	7.51	130	9.74	183	12.62
Distillate (Gallons)	17	.96	107	5.38	142	5.96	104	5.58	192	10.76	112	5.73
Oil (Gallons)	46	25.44	49	19.59	28	13.33	40	19.60	49	24.52	42	20.50
Grease (Pounds)	26	2.75	22	2.43	13	1.62	48	5.16	26	2.96	27	2.98
Total fuel, oil and grease	xx	124.40	xx	105.51	xx	77.14	xx	102.47	xx	132.56	xx	108.42
Other costs:												
Labor		8.50		8.87		9.20		7.50		5.21		7.86
Repairs		22.26		30.46		29.92		28.91		21.19		26.55
Interest		33.72		26.52		22.62		26.40		39.72		29.79
Depreciation		87.84		92.59		73.32		38.89		103.92		79.31
Shelter, water, etc.		8.00		8.00		8.00		8.00		8.00		8.00
Taxes		4.47		2.33		1.49		2.42		2.92		2.73
Total other costs		164.79		168.77		144.55		112.12		180.92		154.24
Total cost per farm		289.19		274.28		221.69		214.59		313.52		262.66
Total cost per day's work		6.43		5.27		4.43		5.23		4.82		5.15

Table 16. Cost of four-row tractor work per farm and per day's work, 1934-1935.

	1934		1935		Two-year average	
Acres in crops	308		363		336	
Acres in cotton	119		139		129	
No. farms with tractors	4		7		6	
No. of tractors	4		7		6	
Average value per tractor	$932.31		$939.36		$935.84	
Days worked per tractor	42.1		77.7		59.9	
Fuel	Amount	Value	Amount	Value	Amount	Value
Gasoline (Gallons)	1,524	$118.90	1,836	$156.11	1,680	$137.50
Kerosene (Gallons)	—	—	49	3.16	24	1.58
Distillate (Gallons)	149	7.21	557	32.27	353	19.74
Oil (Gallons)	55	23.62	93	41.22	74	32.42
Grease (Pounds)	27	3.71	39	4.44	33	4.08
Total fuel, oil, and grease	xx	153.44	xx	237.20	xx	195.32
Other costs:						
Labor	$ 7.60		$ 9.66		$ 8.63	
Repairs	25.01		32.66		28.83	
Interest	55.94		56.36		56.15	
Depreciation	201.25		186.62		193.94	
Shelter, water, etc.	8.00		8.00		8.00	
Taxes	3.08		3.96		3.52	
Total other costs	300.88		297.26		299.07	
Total cost per farm	454.32		534.46		494.39	
Total cost per day's work	10.79		6.88		8.25	

own repair work rather than hiring this work done by mechanics at a relatively high wage, no doubt was responsible to a great extent for keeping repair costs low. The principal part of tractor repair costs was for new parts that were replaced. Repairs were also kept low by the fact that the farm operator or some member of the farm family usually ran the tractor rather than depending on inexperienced or careless hired labor for tractor operation.

The cost per day of two-row tractor work averaged $5.15 for the 5-year period and varied from $6.43 in 1931 to $4.43 in 1933. (See Table 15.) Differences in prices paid for fuel and variation in the number of days worked per tractor were important causes of year-to-year differences in the cost of two-row tractor work.

Since more power is required for four-row equipment than for two-row equipment, four-row tractors were more expensive to operate than two-row tractors. The average cost per day of four-row tractor work was $10.79 in 1934 and $6.88 in 1935. The difference in cost between the two years was largely due to the difference in the number of days worked per tractor.

These data also indicate that the number of days worked per tractor was an important consideration of tractor costs. In order to better study this factor, the farms were grouped according to the number of days worked per tractor per year regardless of size. These data are summarized in Table 17. The average cost per day of tractor work was $8.01 for farms that used a tractor less than 40 days as compared to $4.51 for farms that had 60 or more days of tractor work and $5.96 for those that ranged between 40 and 59 days work per tractor per year.

Expenses for fuel, oil, and grease vary directly with the days of tractor

Table 17. Cost of tractor work on farms grouped according to number of days worked per tractor per year, average 1931-1935.

	Days worked per tractor per year		
	Less than 40	40-59	60 and over
Acres in crops	225.8	261.8	345.3
Acres in cotton	92.3	101.9	129.0
Number of farms with tractors	58	52	71
Number of tractors	58	52	77
Average value per tractor	478	569	575
Days worked per tractor per year	27	49	76
	Dollars	Dollars	Dollars
Fuel	59.19	93.38	121.46
Oil	16.70	20.41	27.57
Grease	2.95	2.42	3.81
Total fuel, oil, and grease	78.84	116.21	152.84
Other costs:			
Labor	6.99	6.42	8.55
Repairs	23.39	18.67	33.10
Interest	28.68	34.14	34.50
Depreciation	67.88	105.41	102.32
Shelter charge	8.00	8.00	8.00
Taxes	2.51	2.97	3.11
Total other costs	137.45	175.61	189.58
Total cost per farm	216.29	291.82	342.42
Total cost per day's work	8.01	5.96	4.51

work. Repair costs usually vary with the amount of tractor work done and with the age of the tractor. New tractors require fewer repairs than old ones. Extensive use of a tractor is usually accompanied by relatively high depreciation. Interest, shelter, and taxes do not vary greatly from year to year and are not greatly affected by the amount the tractor is used.

Since the major out-of-pocket costs of tractor operation are for fuel, oil, and grease, farmers frequently consider that these costs make up the bulk of the cost of tractor work. Data in Tables 15 and 16 indicate that this is not true. Fuel, oil, and grease made up only approximately 40 per cent of the total cost of tractor work while labor, repairs, interest, depreciation, shelter, and taxes accounted for 60 per cent of the total costs. It may be seen in Table 17 that the proportion of the total cost of tractor work made up by fuel, oil, and grease also increased with an increase in the days of tractor work.

Choosing the Power Unit

The acreages of cropland that can be operated with a single set of each of the common types of power and equipment used in the area are shown in Table 18. These figures should be useful to farmers in planning their power and equipment needs. Because cotton is the most important crop, the acreage of cotton that can be readily handled with each type of equipment was the principal consideration.

These figures are based on usual rates of performance with different sizes of power and equipment units on the farms studied and upon an estimated optimum length of cultivation period for once-over of all crops of ten days. The figures in Table 18 do not differ greatly from the actual acreages handled in 1936 by farmers using comparable sets of equipment. (Last column in Table 10.)

Table 18. Cropland operated per unit of the types of power and sizes of equipment common in the area.

	Acres of cropland per farm
One-row horse-drawn	100
Two-row horse-drawn	180
Two-row tractor-drawn	250
Four-row tractor-drawn	450

One man can operate, with the help of extra labor for hoeing and harvesting, approximately 100 acres of cropland with one set of single-row horse-drawn equipment or 180 acres with two-row horse-drawn machinery. The acreage can be increased to 250 by the use of two-row tractor equipment and to 450 when four-row tractor equipment is used.

The acreage that can be operated with a given power unit will vary somewhat from farm to farm, depending on soil types, and cropping system. Planting is the critical operation in crop production and since effective erosion control reduces the necessity for replanting, the ability of a farmer to control erosion affects the crop acreage that can be operated.

Because of a longer planting period and lower labor and power requirements per acre, a farmer can plant and cultivate a larger acreage of feed than cotton acreage, assuming the same power unit is used. Favorable climatic conditions tend to increase the acreage that can be handled.

Since tractors do not require rest, it is possible for farmers to increase the acreage operated per tractor by providing extra labor and working at night when necessary. Such a practice will not reduce the total hours of service rendered by the tractor and equipment but will necessitate more frequent replacement bcause of more intensive use.

Tractorpower has the advantage of affecting a saving of time and man labor. Since a tractor operates at greater speed than horse-drawn machinery, it is possible to operate more cropland with the same labor force with tractorpower than with horsepower. The fact that a tractor can be run long periods without rest results in increased timeliness in the performance of field operations.

A two-row and a four-row tractor outfit usually replaces 6 to 8 and 12 to 15 head of workstock, respectively. The shift to tractorpower has resulted in an increase of between 20 and 25 per cent in the amount of power available per 100 crop acres. This has given the operator better control of planting and cultivating operations and at the same time permitted a saving of labor for field work other than hoeing and harvesting. During rush periods the tractor can be run day and night if need be. A power reserve of this nature is especially important in an area where the optimum planting time is frequently short and where timely cultivation may result in subsequent labor savings.

Size of farm is an important consideration in the choice of farm power. The advantage due to the saving in time and labor that is obtained by shifting from horse to tractorpower, is lost unless the saving of labor can be profitably utilized to increase production. Assuming sufficient power for the needs of his business, a farmer would not be justified in greatly increasing the size of power unit, unless he can increase the extent of his operations to utilize the additional power. If management is to be most efficient, the available power and labor must be employed.

Because of ownership and personal factors, some farms will no doubt remain small and adapted only to horsepower. A small farm offers older *farmers a gradual retreat from the land.* Older farmers frequently prefer to use workstock. Additional use of tractors on small farms may take place with recent developments in the machinery field, which include general purpose tractors adapted to one-row equipment. Inability to increase the size of farm would also greatly hinder an increase in the use of four-row tractor equipment.

Approximately 50 per cent of the cost of tractorpower is cash expense, while cash items make up only 5 per cent of the cost of maintaining workstock. The relatively lower cash cost is an important advantage in favor of horsepower over tractorpower. Feed is a large item in the cost of maintaining workstock. Most of the feed fed is home-grown and is produced with very little outlay of cash. The use of workstock provides an additional outlet for the feed crops grown. *Due to lower cash costs, the* farmer with horsepower requires a smaller reserve of cash or a smaller *amount of credit than one using tractorpower. Utilization of home-grown* feeds may reduce some of the risks of farming.

Tractors have an advantage in that no fuel or attention is required when they are idle, while workstock require some feed and care whether they work or not. This factor is most important during periods of high feed prices.

Terraced cropland does not lend itself to the use of four-row tractor equipment as well as to smaller machinery. Farmers find it somewhat difficult to work the terraces with the larger-sized power units. The point rows that usually occur on land that is either terraced or contoured are also more difficult to handle with four-row machinery than with smaller equipment. Should it become the common practice to terrace the cropland of the area, terracing will doubtless offer resistance to the increased use of four-row equipment.

ADJUSTMENTS IN FARMING SYSTEMS

Farmers find it advisable to consider periodic adjustments in farm organization in response to changes in price relationships, variations in market demand, introduction of improved equipment or numerous other changes which affect the farm business. During recent years farmers have found it necessary to make numerous and rapid adjustments as a result of government crop-control programs. The principal problems in this connection have been centered about the use of land diverted from cotton production or the disposal of feed crops grown on land diverted from cotton.

It is the purpose of this section to indicate something of the extent and nature of the problem of making these adjustments as well as to discuss the principal alternatives in farm enterprises which are available. As a starting point typical systems of farm organization previous to the activities of the Agricultural Adjustment Administration are shown. This is followed by a discussion of changes necessitated as a result of these activities and a consideration of the alternative adjustments available to farmers of the area.

Typical Systems of Farming Previous to the Advent of the Agricultural Adjustment Administration

Cropland made up approximately 84 per cent of the total land area of the farms studied. (See Table 19.). The remainder was in native pasture, farmstead, roads, and idle land. Previous to government crop control activities, cooperating farmers planted, on an average, nearly one-half of their cropland to cotton and the remainder to various feed and annual pasture crops.

Table 19. Organization of farm land and of cropland, average of farms studied, for the period 1931-1935.

Items	1931		1932		1933		1934		1935		5-year av.	
Number of farms	141		138		127		139		138		137	
Total acres in farm	290		288		271		263		268		276	
Cropland per farm	237		241		218		235[1]		222		231	
Per cent of total acreage	81.7		83.7		80.4		89.5		82.8		83.6	
Native pasture, farmstead and roads	53		47		53		28		46		45	
	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent
Cropland in:												
Cotton[2]	104	43.8	107	44.4	116	53.2	63	26.8	72	32.3	92	39.8
Milo	52	22.1	45	18.8	32	14.8	36	16.8	56	25.5	44	19.0
Kafir	16	6.9	18	7.6	9	4.3	12	5.2	14	6.4	14	6.1
Hegari	19	8.1	19	7.7	16	7.5	19	8.2	29	13.1	20	8.7
Cane	8	3.3	8	3.2	12	3.8	9	3.8	9	4.1	9	3.9
Sudan	18	7.7	16	6.8	18	8.5	19	8.8	24	12.3	19	8.2
Corn	6	2.6	11	4.4	5	2.3	5	2.0	6	2.6	7	3.0
Small grains[3]	13	5.4	14	5.7	8	4.5	11	6.0	10	5.1	11	4.7
All other crops	3	1.2	6	2.7	3	1.6	5	2.4	4	1.8	4	1.7

[1]Includes 56 acres of idle cropland.
[2]Acreage previous to Government plow-up for 1933, harvested acreages for other years.
[3]May include some double cropping.

The average numbers of livestock kept per farm are shown in Table 20. The number of workstock on farms studied decreased after 1933 and reflects the shift from horse- to tractorpower that has been previously discussed. Previous to 1934, the average farm had 5 to 6 cows, a little more than

Table 20. Average numbers of livestock on the farms studied during the period 1931-1935.

Items	1931	1932	1933	1934	1935	5-year av.
Number of farms	141	138	127	139	138	137
Workstock per farm........Number	6.2	6.2	6.4	5.9	4.6	5.9
Cows per farm............Number	5.2	5.8	6.1	4.9	4.0	5.2
Litters of pigs per farm...Number	1.5	2.9	2.4	.7	1.1	1.7
Hens per farm............Number	116	105	104	99	84	102

100 hens, and raised approximately two litters of pigs per year. The feed shortage that resulted from the drought of 1934 caused some reduction in numbers of cattle, hogs, and poultry.

Although it was common to find a large percentage of land in crops, some farms varied considerably from the average crop and livestock organization. While cotton was of major importance on most farms, variations in land resources resulted in differences in cropland organization. Grain sorghums were most extensively grown in localities where the predominating soils are at least favorable to cotton production. Whether surplus feed was sold as cash grain or marketed through livestock was largely determined by personal preference and the experience of the farmer, and by existing price relationships.

Farms which were typical of the four systems of farming most commonly found in the area previous to Agricultural Administration programs were selected. A budget analysis was made for each of these systems. In the construction of these budgets the crop and livestock organization of the farm, the amount of feed used, the amount of feed purchased, the hours of labor on livestock, the livestock production obtained, and the amounts of products used in the home are taken from the records of the individual farms selected as typical of each farming system. Average figures obtained for all the farms studied were used for the following items: crop yields, hours of man labor and power used on crops, tractor operating costs, amounts of seed planted, depreciation rates and repairs for improvements and equip-

Table 21. Average repair and depreciation rates for specific items, expressed as a percentage of original costs.

Items	Repairs	Depreciation
Farm buildings (residence excluded)	2.0	5.0
Fences	4.5	5.0
Machinery (tractor and automobile excluded)	4.0	7.0
Tractor	3.0	8.0
Automobile	5.0	17.0
Workstock		7.0

ment, taxes, prices of products sold and materials and services purchased, and value per unit of farm products used by the farm family. Average figures rather than actual figures were used for these items to eliminate the effects of factors such as climatic conditions, price differences and soil variation. The farms selected to represent the typical systems of farming all used two-row tractor-drawn equipment.

Rates used to calculate repairs and depreciation were based on the experience of cooperating farmers and are shown in Table 21.

Price data were obtained from cooperating farmers, feed and grain dealers, and newspapers in the area. The prices used in the budgets were averages for the 8-year period 1929-1936, as shown in Tables 22 and 23.

Table 22. Prices of products sold.

Commodity	Unit	1929	1932	1935	8-year average 1929-36	1942
		Dollars	Dollars	Dollars	Dollars	Dollars
Cotton lint	cwt.	16.20	5.30	10.13	9.75	17.00
Cottonseed	ton	29.70	7.20	30.00	22.00	40.00
Milo (threshed)	cwt.	1.12	.27	1.28	.89	1.12
Kafir or Hegari (threshed)	cwt.	1.03	.29	1.18	.82	1.08
Corn	bu.	.59	.19	.90	.55	.80
Wheat	bu.	1.01	.27	.95	.72	1.06
Kafir or Hegari (bundles)	ton	8.50	2.00	10.70	6.70	9.00
Cane bundles	ton	7.50	2.40	10.00	6.55	8.00
Cattle	cwt.	5.25	1.75	3.95	3.25	9.00
Butterfat	lb.	.41	.18	.30	.27	.38
Hogs	cwt.	8.85	3.50	8.90	6.55	12.50
Pigs (weaning)	each	5.00	2.00	4.50	3.50	6.00
Eggs	doz.	.23	.11	.18	.16	.28
Hens	lbs.	.16	.08	.10	.11	.18
Fryers	lbs.	.15	.10	.12	.12	.23
Sudan seed	cwt.	4.00	.70	7.60	3.50	3.00

Table 23. Prices of items purchased.

Commodity	Unit	1929	1932	1935	8-year average 1929-36	1942
		Dollars	Dollars	Dollars	Dollars	Dollars
Wages—without board	day	1.25	.85	1.25	1.10	3.00
Contract work:						
Thresh grain sorghums	cwt.	.12	.04	.08	.08	.10
Thresh Sudan	cwt.	.25	.12	.20	.20	.20
Snap cotton	cwt.	.75	.30	.50	.50	1.10
Bind sorghums	acre	1.25	1.00	1.00	1.00	1.50
Ginning	*(acre*	*2.91*	*2.12*	*2.12*	*2.50*	*2.97*
	(cwt.	.35	.25	.25	.30	.315
Bagging and ties	bale	1.25	1.00	1.25	1.10	2.10
Binder twine	8# ball	1.00	.65	.70	.80	1.00
Baby chicks	each	.10	.06	.09	.08	.10
Seed:						
Cotton	bu.	*2.00*	*1.00*	*1.25*	*1.35*	*2.00*
Milo, Hegari, and kafir	cwt.	4.00	2.00	3.50	3.00	4.00
Cane	cwt.	4.00	1.25	4.50	2.90	3.50
Sudan	cwt.	5.00	.90	9.50	4.35	3.50
Corn	bu.	2.50	1.60	2.80	2.00	3.00
Wheat	bu.	1.20	.45	1.05	.87	1.15
Feed:						
Cottonseed meal	cwt.	1.60	.95	1.85	1.55	2.20
Tankage	cwt.	3.50	2.00	2.50	2.55	4.00
Chick mash	cwt.	3.25	2.10	3.00	2.75	3.50
Laying mash	cwt.	3.00	1.75	2.60	2.40	3.00
Bran	cwt.	1.60	.75	1.50	1.30	1.90
Shorts	cwt.	1.80	1.00	1.65	1.50	2.10
Oyster shell	cwt.	1.25	1.00	.90	1.00	1.00
Tractor fuel:						
Gasoline (less tax)	gal.	.12	.09	.08	.095	.09
Kerosene	gal.	.08	.07	.07	.07	.07
Distillate	gal.	.05	.05	.06	.05	.06
Lube oil	gal.	.60	.40	.50	.52	.52
Grease	lbs.	.10	.11	.11	.11	.11

The most common system of farming previous to the Agricultural Adjustment Administration programs included a substantial cotton acreage. In some cases cotton was produced on a large part of the cropland and was the only major source of income. No more feed was grown than needed by the livestock maintained to supply the home needs. Such a system is herein spoken of as the "cotton system."

Table 24. Budget summaries for typical systems of farming in the High Plains Area previous to government crop control with average prices for 1929-1936.

	Cotton system	Cotton, grain sorghum, livestock system	Grain sorghum, livestock system	Cash grain system
	Acres	Acres	Acres	Acres
Total land in farm	280	280	304	280
Native pasture	11	33	58	7
Farmstead	4	5	6	4
Cropland	265	242	240	269
Amount of cropland in:				
Cotton	200	100	45	—
Milo	30	36	90	109
Kafir		15	12	51
Hegari		24.5	16	70
Cane	22	37.5	20	16
Corn	—	—	12	13
Sudan pasture	13	29	42	10
Idle	—	—	3	—
	No.	No.	No.	No.
Livestock:				
Cows	3	8	18	4
Bulls	—	1	1	—
Sows	—	—	1	1
Meat hogs only	2	4	—	—
Poultry	135	500	215	125
Workstock	2	4	4	2
	Dollars	Dollars	Dollars	Dollars
Total farm investment	10,983	11,866	12,835	11,150
Land	8,400	8,400	9,120	8,400
Improvements (less residence)	1,000	1,000	1,000	1,000
Machinery and equipment	1,125	1,350	1,350	1,250
Livestock	352	865	1,023	362
Feed, seed and supplies	107	251	342	138
Farm sales—total	4,458	3,702	2,210	1,701
Amount of sales from crops	4,297	2,315	1,278	1,428
Amount of sales from livestock and livestock products	161	1,387	932	273
Farm expenses—total	1,803	1,522	828	691
Amount of expense for:				
Improvements (less residence)	34	34	34	34
Machinery and equipment	301	276	254	256
Crops	597	309	202	139
Livestock	19	464	81	95
Hired labor:				
Cotton harvesting	692	346	156	—
Other	67	—	—	74
Taxes	93	93	101	93
Total farm sales	4,458	3,702	2,210	1,701
Value of products used in home including garden	255	226	258	221
Gross farm income	4,713	3,928	2,468	1,922
Total farm expense	1,803	1,522	828	691
Unpaid family labor	—	343	114	—
Decrease in inventory	255	167	277	290
Total deductions	2,058	2,032	1,219	981
Return to capital and operator's labor and management	2,655	1,896	1,249	941
Interest on investment at 6 per cent	659	712	770	669
Labor and management wage	1,996	1,184	479	272

The Cotton System

A summary budget of a typical farm using the cotton system is given in column one of Table 24. Cotton is the principal money crop of the area. It is not perishable, is easily marketed, and has a high per-unit value. These factors are important, considering the great distance from central markets. Most of the people who settled the area were familiar with cotton production. It is natural, therefore, that a crop as well adapted as is cotton would be extensively grown. Cotton lends itself to the extensive type of farming practiced. The farm family, with the aid of seasonal labor for hoeing and harvesting, can produce a large acreage of cotton.

The cotton system requires a minimum investment in improvements, equipment, and livestock. Farmers using this system were more mobile than those with extensive livestock enterprises. For this reason the system is popular with tenant farmers. Ease of collecting rents, ease of marketing, and greater income possibilities, causes landlords generally to favor this system.

On the other hand, this system has the disadvantage of depending on a single crop for a major part of the farm income. Wide variations in income are likely to occur because of variations in yields and prices of cotton.

Farmers practicing this system of farming are likely to find the control of soil erosion more difficult than for systems which include larger acreages of crops like the sorghums which have root systems that bind the soil and which provide a heavy crop aftermath.

Since the optimum planting period for cotton is relatively short, a large cotton acreage is more likely to be accompanied by critical labor peaks than is the case when the cropping system includes crops which permit a long planting period. The cotton system returned more income to the operator during the period of study, than did any of the other three typical systems. The return to capital and operator's labor and management for the cotton system was $2,655. To denote a successful system of farming, this figure must be large enough to cover the interest on the invested capital and return a satisfactory wage for the operator's labor and management. Otherwise the operator might profit more by selling his property and investing the proceeds to draw interest while he himself works for wages. Subtracting interest at a fair rate (6%) from the above figure leaves the operator a labor and management wage of $1,996. This amount represents a very good return considering the conditions prevailing during the period of the study.

Cotton, Grain Sorghum, Livestock System

The cotton, grain sorghum, livestock system was more diversified than the cotton system (See column two, Table 24). Livestock, as well as crops, was a major source of income with this system of farming. The poultry enterprise on this farm was well managed and much larger than that maintained on most farms in the area. Dairy cattle were also an important source of income. The income for this system of farming is less affected by fluctuation of the yield of a single crop or the price of a single commodity than is the case with the cotton system. The livestock enterprises usually associated with this system provide a steady income throughout the year. This in turn reduces the need for credit.

Including livestock in the farm organization provides for better distribution of labor and for fuller utilization of the time of the farm family. A great deal of the labor in connection with livestock is chore work, a large part of which can be done by children before and after school. Less hired labor is used with this system than with the cotton system. This is largely owing to a difference in labor used to harvest cotton and to better distribution of total labor requirements.

This system of farming calls for more different skills on the part of the operator than does a system that includes only crop production. It is also important that the operator be permanently located to manage the livestock enterprises to the best advantage.

The grain sorghum crops which are included in this system provide considerable stalks, stubble, and crop residue with which to facilitate wind erosion control. This is advantageous on those farms that have a serious wind erosion problem.

Although the cotton, grain sorghum, livestock system does provide a substantial acreage of cotton, it does not make full use of the income advantage of cotton over other crops and livestock production in the area. The livestock enterprises and feed production take time and labor, a part of which might have been more profitably used in the production of cotton.

This system requires additional investment in the farm business for livestock and equipment. Larger feed reserves must also be maintained in order to avoid losses resulting from feed crop failures or from wide variations in feed yields. On the other hand, the returns to labor and management from this system were less than two-thirds of the returns from the cotton system.

Grain Sorghum, Livestock System

The grain sorghum, livestock system differs from the cotton, grain sorghum, livestock system in that in the former, feed crops largely supplant cotton and a larger number of livestock are maintained. Surplus grain sorghums are sold for cash. The financial summary of a budget for a grain sorghum, livestock farm is shown in column three of Table 24.

This system is best adapted to the light sandy soils of the area which are not well suited to cotton production. These soils are the loamy fine sands and the lighter phases of the fine sandy loams on which wind erosion is a constant hazard. It is difficult to establish a stand of cotton on these soils. On the other hand, the large acreages of grain sorghums grown under this system greatly facilitate erosion control.

The grain sorghum, livestock system provides for a reasonably good distribution of both income and labor. From the standpoint of total income, however, it compares unfavorably with the two systems previously discussed. This is shown by a labor and management wage of $479 for this system as compared to $1,996 and $1,184 respectively, for the cotton system and for the cotton, grain sorghum, livestock system.

The Cash Grain System

Farmers who use the cash grain system also specialize in growing grain sorghums but prefer to market the crop as cash grain rather than feed it to livestock. A budget for the cash grain system is given in column four of Table 24. This system is best suited to localities that are not well adapted to cotton production or where wind erosion control is particularly difficult.

The profitableness of this system as compared to feeding a large part of the feed to livestock will depend largely upon the price relations that exist between cash grain and the various livestock products that are commonly marketed.

The cash grain system of farming is subject to large variations in income because of wide fluctuations in grain sorghum prices and variations in yields. Low prices for feeds are not uncommon in the area and are usually accompanied by low cash incomes for cash grain farmers. This system is less dependent on outside labor than any of the systems previously discussed. The average farm family can plant, cultivate, and harvest the entire crop with little or no outside labor. The farm family labor, however, is poorly utilized except during peak periods of crop work.

A labor and management wage of $272 from the cash grain system was lower than was obtained for any of the three systems that have previously been discussed. This would indicate that with production conditions as outlined and the average prices obtained during the period 1929-1936, farmers following the cash grain system of farming had a distinct disadvantage as compared with those who grew a sizeable acreage of cotton. It further indicates that it was not profitable to use the cash grain system on land which is well adapted to cotton production.

Adjusting Systems of Farming Within Limitations of Agricultural Adjustment Administration Program

During the years 1938 to 1942 inclusive, the Agricultural Adjustment Administration program has followed the same general plan whereby the cotton allotment for each farm was set at a fixed percentage of the acreage in cultivation. This percentage was uniform for the farms of each county but varied somewhat from county to county. On an average, farmers in the area participating in the Agricultural Adjustment program have planted an acreage of cotton equivalent to approximately 35 per cent of their cultivated acreage. During this period grain production has also been affected to the extent that farmers devoted a proportion of their cropland exclusively to uses designated as soil conserving. In 1942 the minimum conserving acreage was 20 per cent of the total cropland. This meant that not to exceed 80 per cent of the cropland on a farm was devoted to the production of all crops classed at soil depleting. Such crops included cotton and grain sorghums grown for grain.

As a result of the Agricultural Adjustment Administration program, systems of farming which were common previous to 1938 required drastic adjustments. Farmers who had been using the "cotton system" type of farm organization abandoned this system entirely if they cooperated in the Agricultural Adjustment program. Under this program such farmers grew only their allotted acreage of cotton, which would range from approximately 30 to 37 per cent of the total cropland for the main cotton growing counties of the area. The remainder of the acreage allotted to soil depleting crops could be devoted to grain sorghums or other feed crops. These feed crops could either be sold for cash or fed to livestock.

Farmers who in the past followed the practice of planting 40 to 50 per cent of their cropland in cotton, as was common with the type of farm organization described as the "cotton, grain sorghum, livestock system," modified their farming operations by reducing cotton acreage when they participated in the Agricultural Adjustment program. Farmers in this group had little opportunity to expand the acreage of crops grown for grain. On farms where only a small reduction in cotton acreage was required, the acreage of grain also had to be reduced.

Farmers growing only a small acreage of cotton as was the case of those using systems similar to the ones described as the "grain sorghum, livestock system" and the "cash grain system" have not found it necessary to adjust cotton acreage. In fact some of these operators can and are growing more cotton than they grew previous to 1933. In many cases such operators have found it necessary to adjust feed crop production in order to comply with the program provision that 20 per cent of the cropland be devoted to designated soil-conserving crops or land uses. In general, the greater the proportion of cropland which had been devoted to cotton the more drastic the adjustments necessitated by the Agricultural Adjustment Administration program.

Judging from past experience as large an acreage of cotton as allotted under the Agricultural Adjustment Act should be grown and sorghum for grain planted on the remainder of the soil depleting acreage. Because of its importance as a cash crop, cotton should be grown on land best suited to cotton production. The acreage restricted to soil conserving crops may be planted to annual pasture crops such as Sudan or may be utilized for forage production.

A budget analysis was made for each of six alternative systems of farming within the limits of the Agricultural Adjustment Administration program. A summary of these budgets are shown in Table 25. Prices which prevailed during 1942 were used in calculating these budgets. In preparing the budgets a farm was selected which would provide efficient use of a single set of two-row tractor-drawn equipment under the "cotton system" as previously described. In all cases it is assumed that the grain sorghums grown for grain will be harvested with a combine.

Average labor requirements and yields were used for the crops grown and normal feed requirements and production were assumed for livestock. Farmers in the area have been able to earn nearly all of their soil building allowance by practicing contour listing and contour farming of intertilled crops. In all budgets it was assumed that these practices would be followed.

Cash Feed System

The "cash feed system" illustrated in column one of Table 25 is for a 280-acre farm with 250 acres of cropland. Thirty-five per cent of the

Table 25. Budget summaries of alternative systems of farming using 1942 prices.

	Alternatives under A.A.A.					
	Cash feed	Swine & dairy	Swine, dairy, & poultry	Beef cattle	Increased size	Maximum mechanization
	Acres	Acres	Acres	Acres	Acres	Acres
Total land in farm	280	280	280	280	340	600
Native pasture	25	25	25	25	35	55
Farmstead	5	5	5	5	5	5
Cropland	250	250	250	250	300	540
Amount of cropland in:						
Cotton	87.5	87.5	87.5	87.5	105	189
Grain sorghum grain	112.5	112.5	112.5	112.5	135	243
Cane	45	20	20	30	55	103
Sudan pasture	3	15	15	8	3	3
Small grain pasture	2	15	15	6	2	2
	No.	No.	No.	No.	No.	No.
Livestock:						
Dairy cows	2	10	10	4	2	2
Beef calves	—	—	—	50	—	—
Sows	—	7	5	—	—	—
Hogs for meat only	4	—	—	4	4	4
Poultry	100	100	500	100	100	100
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Total farm investment	12,716	13,863	14,355	15,105	14,816	24,711
Land	9,800	9,800	9,800	9,800	11,900	21,000
Improvements (less residence)	1,120	1,215	1,455	1,300	1,120	1,240
Machinery adn equipment	1,550	1,550	1,550	1,650	1,550	2,225
Livestock	190	779	1,085	1,790	190	190
Feed, seed, and supplies	56	519	465	565	56	56
Farm sales—total	4,753	6,039	6,551	7,885	5,695	10,353
Amount of sales from:						
Crops	4,521	3,095	3,107	3,088	5,463	10,121
Livestock and livestock products	232	2,944	3,444	4,797	232	232
Farm expenses—total	1,499	1,827	2,253	4,452	1,856	2,123
Amount of expenses for:						
Improvements (less residence)	38	41	51	42	38	42
Machinery and equipment	344	327	328	338	388	801
Crops	319	321	321	319	382	690
Livestock	75	249	654	2,935	75	75
Hired labor:						
Cotton harvesting	612	667	667	667	800	—
Other	18	123	123	33	60	315
Taxes	93	99	109	118	113	200
Total farm sales	4,753	6,039	6,551	7,885	5,695	9,999
A.A.A. payments	316	316	316	316	369	682
Value of farm products used in home, garden included	429	429	429	429	429	429
Gross farm income	5,498	6,784	7,296	8,630	6,493	11,110
Total farm expense	1,499	1,827	2,253	4,452	1,856	2,123
Unpaid family labor	210	210	210	210	210	210
Depreciation	279	285	297	288	321	395
Total deductions	1,988	2,322	2,760	4,950	2,387	2,728
Return to capital and operator's labor and management	3,510	4,462	4,536	3,680	4,106	8,382
Interest on investment at 6%	763	832	861	906	889	1,483
Labor and management wage	2,747	3,630	3,675	2,774	3,217	6,899

cropland or 87.5 acres is devoted to cotton, 112.5 acres to grain sorghums and the remaining 20 per cent of the cropland to cane and annual pasture crops. Livestock were kept primarily to provide for home needs and consisted of 2 cows, 4 meat hogs and 100 hens.

Cash sale of cotton, grain sorghum grain and cane bundles constitute the only important source of income for this system of farming. Such a system is typical of a farm organization where the operator chose to dispose of feed surpluses on the cash market rather than through livestock. This system of farming represents the minimum possible adjustment for farmers who were using the cotton system previous to the activities of the Agricultural Adjustment Administration.

Farmers who plan to use this system of farming will frequently find it very desirable to have more storage space for grain than has been available on many farms. Otherwise, the operator may be forced to sell on an unfavorable market or run the risk of considerable loss from waste or weather damage if threshed grains are left exposed for any length of time.

With prices which prevailed during 1942, this system of farming was estimated to provide a labor and management wage of $2,747 in addition to returning 6 per cent on the investment. This return was the lowest of the six alternative systems shown in Table 25.

A large increase in the amount of feed crops sold on the cash market would normally be expected to have a depressing effect on prices. It is also reasonable to expect that because of the Agricultural Adjustment Administration program the demand for feed would be less in areas which previously did not produce sufficient feed for their needs. Such areas will need to purchase less feed because of the increased feed acreage resulting from this program. The prospects for an increase in supply coupled with a decrease in demand suggest the advisability of considering various livestock enterprises as an outlet for the surplus feed from a system of farming similar to that just described as the "cash feed system."

The requirement which prevailed through 1942, that at least 20 per cent of the cropland be devoted to crops such as Sudan or cane, provide a large amount of forage, either in the form of grazing or as bundle feed or silage. Those who plan to utilize feed crops with livestock have the problem of using this forage in addition to the grain which is produced.

Dairy cattle, beef cattle, and sheep all use forage as well as grain and provide the only outlet, other than the cash market, for the large amount of roughage normally produced. Swine and poultry consume large amounts of grain but utilize very little pasture or forage.

It has been shown that dairying was the most important livestock enterprise in the area and that dairy cows were maintained on nearly all farms. Since the farms studied averaged only 5 cows per farm, it would seem that this enterprise might be expanded as an outlet for surplus grain, bundle feed and Sudan pasture. Previous to 1942 the program of the Agricultural Adjustment Administration, in effect, discouraged any appreciable expansion in the number of dairy cows maintained on farms. With the removal of the restrictions relating to the use of soil conserving crops for market, it became possible for those who desired to expand the dairy enterprise to utilize all the surplus pasture and roughage produced without affecting their eligibility to receive Agricultural Adjustment Administration payments.

Swine, Dairy System

The number of dairy cattle needed to utilize the pasture and forage provided by soil conserving crops would not consume all of the grain normally produced. Hogs or poultry or a combination of the two would provide a means for feeding grain not required by the dairy enterprise.

In column two of Table 25 a summary budget is shown for a farm where dairy cattle and hogs utilize the major part of the feeds produced. This type of farm organization is called the "swine, dairy system." The cotton acreage and the cropland in grain sorghum grain, 87.5 acres and 112.5 acres respectively, are the same for this system and the "cash feed system." The only difference in crop organization of these two system is in the use of non-depleting cropland. In the case of the "swine, dairy system," small grain for winter and early spring pasture is increased to 15 acres as is the acreage of Sudan for summer pasture while cane is reduced to 20 acres.

The pasture and forage produced is sufficient for a herd of 10 dairy cows. Grain feed over and above that needed for the dairy cows is sufficient to maintain 7 brood sows and to fatten the pigs raised to a market weight of 200 pounds. A flock of 100 hens completes the livestock organization.

In general, farmers have had experience with dairy cows and for the average farm an increase in the dairy enterprise sufficient to utilize surplus roughages would not be a major change in farm organization. Farmers who have children available to help milk are more likely to increase their dairy herds. Some farmers will need very little additional equipment and housing to accommodate this size dairy herd while others will find it necessary to increase their investment in these items.

Most farmers in the area fatten some hogs for home use or for market and could effect some expansion of th hog enterprise with a very small outlay for equipment and breeding stock. However, a large increase, either in the number of sows or fattening hogs, would necessitate additional and better facilities for hog raising as well as additional investment in breeding or market animals. Most farms would require additional housing and fencing. Labor-saving equipment such as self-feeders and pens equipped with running water would be an important means of reducing the labor requirements for pork production on the majority of farms. Hand-feeding and watering are time-consuming but have been practiced because of the small size of the enterprise. Expansion of hog production would increase the importance of making changes in management that save labor. It would also be necessary to give more attention to sanitary precautions and disease control.

A sizable increase in the number of hogs maintained would warrant some changes in feeding practices on a large number of farms. In many cases the supply of skim milk may be sufficient to balance the ration of a few hogs fairly well but would not be adequate to balance the ration for a large number of animals. As the enterprise is expanded, it becomes more important that protein supplements such as tankage or cottonseed meal be used in order to secure the best results with home-grown grains.

Farmers who are considering expanding their hog enterprise should provide a supply of grain ample for the needs of the herd. Assuming average efficiency in the utilization of feed, approximately 1,000 pounds of sorghum grain are needed for each hog fattened to a weight of 200 pounds. With average yields, 1.2 acres of grain sorghum will furnish this amount of grain.

A system of farming which involves enough livestock to utilize home-grown feeds will need more grain storage space than is available on the majority of these farms. Large reserves of feed carried over from years of abundant production are needed to stabilize livestock production.

With 1942 prices, the "swine, dairy system" is estimated to return $3,630 to the operator's labor and management after all deductions have been made and the farm investment has been credited with 6 per cent interest. This figure is materially larger than the estimated return from the "cash feed system." A farming system which includes livestock has the added advantage of providing a steady income throughout the year and for more complete utilization of the farm family labor.

Swine, Dairy, Poultry System

A variation from the "swine, dairy system" would be an organization that includes a sizable poultry enterprise as a means of utilizing grain not required by dairy cattle. Under average conditions, a flock of 100 hens will use about 2,400 pounds of home-grown feed per year. With a flock of this size, waste grain and skim milk makes up an important part of the feed used. As the poultry enterprise is expanded, both of these items would be relatively less important and heavier grain feeding and more liberal use of protein-rich feeds would become necessary.

The crop and livestock organization of the "swine, poultry, dairy system," as shown in column 3 of Table 25 is identical with that of the "swine, dairy system" except that the poultry enterprise is increased to 500 hens while the number of sows kept is reduced to 5.

It was estimated that a labor and management wage of $3,675 would be made with this system of farming. The income difference between the "swine, dairy, poultry system" and the "swine, dairy system" is not significant and indicates that substituting poultry for hog production had little effect on income with prices which prevailed during 1942.

Although the common-sized poultry enterprise does not usually interfere to any great extent with other farm work, chickens do require more labor than is common for other kinds of livestock. Based on the experiences of the farms studied, approximately 750 hours of labor are required to care for a flock of 500 hens which would be expected to consume 25,000 pounds of grain. At the same time only 230 hours of labor are needed to care for the hogs necessary to utilize a similar amount of grain. Farmers who contemplate keeping more hens or raising more chicks take into consideration the amount of help that will be available to care for the enlarged enterprise.

Those who attempt to brood chicks under crowded conditions or without adequate housing and equipment are taking the risk of suffering heavy losses. Crowding of either young chicks or mature hens is hazardous. Heavy death losses and low production are likely to result when the laying flock is increased without providing adequate housing. A substantial increase in the number of hens kept would require additional housing and equipment in most cases. Housing for poultry is relatively more expensive than is required by other types of livestock. The larger the flock the greater the problem of disease and parasite control.

Some farmers have fed beef cattle or lambs as a means of utilizing grain and roughage. These feeding operations have the advantage of being readily adjustable to the feed supply. Those who fatten livestock need not depend on raising their own animals but may buy feeders when the feed supply and price relationships seem favorable. The flexibility of such an undertaking is an important consideration in planning a use for feed surpluses, the amount of which may vary greatly from year to year. A measure of the profitableness of a system of farming that includes a beef cattle feeding enterprise is shown in column four of Table 25.

Beef Cattle System

In the type of organization illustrated, 50 beef calves provide an outlet for the majority of feed crops. This enterprise also utilizes available labor during the slack winter period. The crop pattern for this system of farming is similar to that described for two previous systems except that more cropland is devoted to cane and less to Sudan and small grain pasture. Four dairy cows, 4 meat hogs, and 100 hens would be maintained in addition to the calves on feed.

Assuming price relationships that existed during 1942, this system of farming was estimated to give a labor and management wage of $2,774 in addition to returning 6 per cent on the investment. This return was greater than that estimated for the "cash feed" system but was less than indicated for any of the other alternatives shown in Table 25.

Considerable capital is required to finance even a relatively small cattle feeding project. In addition to the investment in feeder animals, there are very few farms on which a dozen or more calves could be fed without necessitating additional sheds, corrals and feeding equipment.

Cattle feeders have the choice of using a ration high in concentrates or one with a high proportion of forage. In general, the ration may vary from 25 per cent concentrates and 75 per cent roughage (by weight) to 75 per cent concentrates and 25 per cent roughage. Farmers who wish to confine the work of cattle feeding to the winter and spring when they are not busy with crops, must use a relatively short feeding period. Under these conditions it would be necessary to feed heavily of concentrates in order to obtain a high degree of finish. The greater the proportion of roughage used in the ration, the longer the feeding period necessary to fatten the animals. Farmers with a large supply of forage relative to their supply of grain might find a longer feeding period advisable in order to utilize these roughages.

It is necessary to add a protein supplement such as cottonseed meal to the farm feeds normally grown to provide a balanced ration. Threshed sorghum grains should be grounds before feeding.[10] The use of hogs to follow fattening cattle and salvage waste reduces somewhat the advantage of grinding as compared to feeding whole threshed grain.

Full feeding of lambs ordinarily does not fit in as well with the common systems of farming as does cattle feeding. Lambs are usually ready to go into the feed lot during October when farmers are busy with cotton and feed harvest and have little time to devote to other enterprises.

[10]Texas Agicultural Experiment Station Bulletin No. 547, "Fattening Beef Calves on Milo Grain Prepared in Different Ways."

The market demand is for lambs that carry a high degree of finish at a weight of about 90 pounds and not exceeding a weight of 100 pounds. Good quality feeder lambs weigh about 60 pounds and in order to meet the demands of the market must be fattened within a 90- to 100-day period. Thin lambs that weigh 60 pounds in September or early October should be put on feed at once in order to attain the desired finish without going over the required weight. If dry-lot feeding is postponed until the completion of harvest the animals are too heavy to meet the demands of the lamb market when the desired finish has been obtained. Farmers who wish to feed lambs may overcome this difficulty by selecting light weight individuals and running them in stalk fields until after the rush of harvesting. Lambs handled in this way should be put in the feed lot by the first of December. In selecting light weight lambs, care should be taken that thrifty animals are obtained.

To obtain a high degree of finish and at the same time keep the fattened lamb within the desired weight, it is necessary that the ration include a large proportiotn of grain. In general such a ration should consist of approximately 50 per cent concentrates and 50 per cent roughage. The concentrate part of the ration should contain enough protein supplement to balance the home-grown feeds.

Increased Size of Farm

The foregoing discussion dealing with alternative adjustments is centered around a farm unit which provided efficient use of a single set of two-row tractor-drawn equipment under the "cotton system" as carried on prior to government crop control activities. More cropland can be operated with a single set of equipment than previously because of the lower labor requirements and better distribution of planting and cultivating operations when other crops are substituted for cotton. Under the Agricultural Adjustment Administration program it is estimated that 300 acres of cropland would be the optimum acreage for a single set of two-row tractor equipment.

Increasing the amount of cropland under the cash feed system to approximate the optimum acreage is one alternative that can be followed under the program. This type of organization is illustrated in column 5 of Table 25. Assuming that land is available, increasing the size of farm will permit farmers to make reasonably complete use of their operating capital without greatly changing their system of farming or having to learn the techniques involved in new enterprises. This system has the benefit of increased efficiency which is reflected in earnings.

A farmer may increase the size of his farm either by land purchase or by renting additional crop acreage. In either case he competes with other farmers for the land already developed or to be developed.

While some undeveloped land still exists in many localities in the area, opportunities for enlarging farms from this source are rapidly becoming more limited. Many operators have found it advisable to dispose of small units and to move to an outlying locality of undeveloped land where the desired size of farm could be obtained. These opportunities are also limited. Some large blocks of good land remain in native pasture but much of the land that remains unimproved is located where conditions of either soil or climate make it less desirable for crop production than the average land of the area. Because of these limitations adjustments in size of farm take place slowly. Management will no doubt play an important part in deciding which farmers are able to make changes in size of farm. It is natural that the most successful farmers will be in the best position to compete for the cropland necessary to adjust the size of farm upward.

Maximum Mechanization

The general trend has been toward the operation of larger units. Farmers of the area have been quick to take advantage of improvements in machinery and power. Within a period of 15 years they have shifted almost completely from one-row horse-drawn equipment to two- and four-row motorized equipment. More recently improved combines along with the development of varieties of grain sorghums suitable for combining have enabled farmers to complete the mechanization of sorghum grain production.

At present cotton is the only important crop being grown in the area that requires large amounts of hand labor. Harvesting is the missing mechanical link in cotton production. During the past ten years the Texas Station has developed a stripper type harvester which will harvest 95 to 98 per cent of the cotton from varieties developed for mechanical harvesting with only slight loss in grade as compared with other methods of harvesting.[11]

A limited number of these machines were manufactured for distribution in this area in 1943. More will be available in 1944. This development will facilitate a high level of mechanization and will permit control of all crop production operations with minimum dependence on outside labor.

Maximum mechanization as used here means the use of four-row tractor-drawn equipment for pre-harvest operations and mechanical harvesting of cotton and grain sorghums. With this equipment 540 acres would be the optimum crop acreage under the Agricultural Adjustment Administration program. This acreage could be planted, cultivated, and harvested by the average farm family with the help of seasonal hoe labor and a small amount of additional help during harvest.

The summary budget shown in the last column of Table 25 indicates the organization and estimated income for a farm unit assuming maximum mechanization. The acreages indicated for cotton and sorghum grain were the maximum acreages provided under the Agricultural Adjustment program in 1942. Grains and forages in excess of that required to maintain 2 dairy cows, 4 meat hogs and 100 hens would be marketed as in the case of the "cash feed" system. The estimated labor and management wage of $6,899 is nearly double that of other suggested alternatives. A large part of this income advantage is a result of the increased acreage which can be operated with four-row tractor equipment. Mechanical harvesting of cotton and grain sorghums is feasible for farms operated with two-row tractor equipment but the full advantage of mechanization, however, will

[11]H. P. Smith, D. T. Killough, D. L. Jones, M. H. Byrom, Texas Agricultural Experiment Station Bulletin No. 580.

not be obtained unless four-row tractors are used on farm units approximating the optimum crop acreage for a set of such equipment.

Adjustments in Response to Wartime Conditions

Wartime conditions have created an urgent demand for food and feed crops and also for a wide variety of livestock products. Removal of restrictions on crop acreages as a war measure has given farmers much greater latitude in adjusting production to war needs. At the same time the supply of labor available for farm work has been greatly reduced, a fact that needs to be carefully considered in making production plans during the war period. As long as cotton is snapped by hand while sorghum grain is harvested mechanically, there is a wide difference in the way in which a labor shortage affects production of these two crops. Scarcity of labor during the harvesting period is not as great a factor in sorghum grain production as is the case in cotton production. During the remainder of the war period cotton acreage will be influenced to quite an extent by farmer experience in obtaining harvesting labor and by the prospects for labor to gather future crops. Inability to obtain harvesting labor would encourage farmers to expand grain sorghums at the expense of cotton.

Mechanical harvesting of cotton would greatly reduce the requirements for hired labor during harvest and would tend to minimize the effect of a reduced labor supply on crop organization. This would add flexibility and would permit adjustments in crop production in response to changes in war needs. A large proportion of the cropland in the area could be devoted to either cotton or grain sorghums according to the demand. Rapid shifts from cotton to grain sorghums or *vice versa* could be made without fear of aggravating the labor situation at harvest time.

As in peace times, price relationships have an important influence on farm organization. Present government price control activities have greatly affected price relationships between commodities commonly produced in the area.

The fact that ceiling prices for grain sorghums are high relative to the ceiling prices for corn is important. The ratio between corn and hog prices has encouraged pork production and has restricted the normal movement of corn to commercial processors. At the same time ceiling prices for grain sorghums make it more profitable to market these grains for cash rather than through livestock. This situation also favors the growing of grain sorghums instead of cotton as a cash crop, particularly on farms not equipped to harvest cotton mechanically. With mechanical harvesting of cotton, price relationships would largely determine farm organization within the physical limits of the area.

Future government price control policies are unknown and these uncertainties should be considered when planning the farm business. An adjustment in ceiling prices that would place grain sorghums and corn in more nearly their normal relationship would reduce the current advantage of the cash grain market and stimulate livestock production.

Irrespective of the shifts caused by wartime conditions farmers frequently find it necessary to make temporary adjustments in their production plans owing to adverse weather conditions. It may also be desirable to make temporary adjustments from time to time to take advantage of a period of relatively high prices for some product or to avoid a period of low prices for others. By keeping informed as to market outlook for different commodities, farmers are able to take advantage of such price fluctuations as can be anticipated with a fair degree of accuracy. On the other hand, changes in the basic organization of the farm should not be made until the need for such adjustments are indicated by the development of new methods of production which affect costs, changes in demand, or other factors of a rather permanent character.

SUMMARY

The High Plains Cotton Area comprises the southern portion of the Texas High Plains where fine sandy loam soils predominate.

Previously an extensive cattle ranching country, the area has almost completely shifted to crop farming during the past 20 to 30 years. In the shift from ranching to crop farming, many problems of adaptation and adjustment have been encountered. For example, the area was settled largely during the 1920's when cotton prices were high relative to livestock and feed prices. This resulted in a high degree of specialization in cotton production and in capitalization of land at a much higher level than could be sustained with subsequent prices of cotton and other commodities produced on the land. As a consequence, many adjustments in the organization and operation of farms were needed and are being made. This study was made for the purpose of facilitating these adjustments. This Bulletin deals with production and production requirements, the manner in which they are affected by changes in the combination of enterprises and production practices, and in turn, the probable effect of these changes on farm earnings.

The data upon which this study is based were obtained through cooperation with representative farmers who were well distributed over the five main counties of the area. An average of 137 farmers kept complete records of their farm business and supplied information pertaining to production and production practices.

The soils of the area vary in texture from fine sands to heavy clays and clay loams. For purposes of this study, they have been grouped into three classes: (1) fine sandy loam, (2) loamy fine sand, and (3) loams, clay loams, and clays. The fine sandy loams are the dominant soils of the area.

The climate is typically sub-humid. The average annual rainfall of between 18 and 20 inches approaches the lower limits for successful dry-farming and varies greatly in amount from year to year. A high rate of evaporation is significant from the standpoint of its effect on planting opportunities. Moisture in the top soil is removed rapidly after a rain, thereby reducing the number of planting opportunities and the length of the optimum planting period for all crops.

Soil and moisture conservation and fertility maintenance are closely related problems which are dependent upon many of the same practices for solution. Since wind erosion causes the loss of fertile top soil and

also loss of stand of young crops, its control is important both from the long-time standpoint of fertility maintenance and from the standpoint of year to year crop production. Moisture conservation facilitates control of wind erosion. The practices most commonly used to conserve moisture and control wind erosion include: (1) deep listing, (2) chiseling, (3) center furrowing, (4) clean cultivation, (5) terracing, (6) contouring, and (7) frequent use of crops such as grain sorghums that furnish a relatively large amount of slow-decaying crop residue. Farmers consider contouring almost as effective in controlling run-off as terracing. Cultural practices that leave the surface slightly irregular check run-off and the movement of windblown soil particles are preferred to those that leave the surface very smooth.

The physical features are conducive to large-scale methods of production. The light rainfall makes weed control a minor problem, and the smooth surface of the land permits the use of multi-row planting and cultivating machinery. Two-row tractor-drawn equipment is most common although in recent years the number of four-row tractor units has greatly increased.

For the most part the crop pattern is limited to crops that do well under sub-humid conditions. According to census data for the eight counties entirely within the area, cotton occupied 53 per cent of the cropland in 1929. Grain sorghums, a small amount of corn and Sudan grass for pasture and seed largely account for the remainder. An average of 94 per cent of the cooperating farmers grew cotton during the period of the study. More recently under the Agricultural Adjustment Administration program cotton made up approximately 35 per cent of the crop acreage. Sorghums for grain and forage and Sudan grass were expanded to make up the difference.

Normal rates of production, normal requirements of seed and materials, and normal requirements of labor and power, assuming the various types of power and sizes of machines commonly used, are given for each important crop. The usual period of performance of each crop operation and the distribution by months of total labor requirements of each crop are also given.

The first labor peak occurs in July when a major portion of the hoeing is done. The second and greatest labor peak is during the harvest season. Cotton, forage sorghums, and all except early-planted grain sorghums are ready to harvest during October and November.

The average rates of production, the usual requirements for production for each class of livestock and its place in the farm organization are given.

The average cost of maintaining a work animal was $1.04 per day worked. The costs of maintaining a two-row tractor and a four-row tractor were $5.15 and $8.25, respectively, for each day of use.

Optimum crop acreage for an average farm family using a single set of one-row horse-drawn equipment and assuming a full cotton acreage was estimated to be 100 acres. For two-row horse, two-row tractor, and four-row tractor-drawn equipment, the estimated optimum crop acreages were 180, 250, and 450 acres.

Previous to the activities of the Agricultural Adjustment Administration, the most common systems of farming were: (1) cotton, (2) cotton, grain sorghum, livestock, (3) grain sorghum, livestock, and (4) cash grain. Cotton was the only major source of income from the cotton system. The cotton, grain sorghum, livestock system was more diversified and included livestock as a major source of income. The sale of feed crops largely supplemented the income from cotton and livestock in the grain sorghum, livestock system. The sale of grain supplemented to some extent by the sale of livestock and livestock products constituted the main source of income in the cash grain system.

A budget analysis is shown for each of these four systems of farming. The labor and management wage estimated for the cotton system was $1,996, as compared to $1,184, $479, and $272, respectively, for the other systems in the order of listing.

Farmers generally found it necessary to reduce cotton and to grow an increased acreage of forage and grazing crops to comply with provisions of the Agricultural Adjustment Administration program. Based on past experience as large an acreage of cotton as allotted by the Agricultural Adjustment Administration should be grown and sorghum for grain planted on the remainder of the soil depleting acreage. The acreage restricted to soil conserving crops may be planted to annual pasture crops such as Sudan or may be utilized for forage production.

Many of the problems of adjustment center about the disposal of feed crops. Cash sale of forage and grain represents the minimum adjustment but a large increase in the amount of feed crops sold on the cash market would normally depress prices. The prospects for an increase in supply coupled with a decrease in demand suggest the advisability of considering livestock enterprises as an outlet for surplus feed. Dairy cattle, beef cattle, and sheep use forage as well as grain and hogs and poultry consume large amounts of grain but utilize very little pasture or forage. Livestock alternatives for the area are discussed.

With the "swine, dairy system," 10 dairy cows utilize the pasture and forage production provided by soil conserving crops and together with 7 brood sows and 100 hens provide an outlet for the sorghum grain grown. This system was estimated to return a labor and management wage of $3,630 with prices which prevailed during 1942.

The crop and livestock organization of the "swine, poultry, dairy system" is identical with that of the "swine, dairy system" except that 400 hens were substituted for 2 brood sows. This change had no significant effect on income using 1942 prices.

With the "beef cattle system" 50 calves provide an outlet for feed crops. The calves would be purchased and fed out during the slack winter period. The flexibility of such an enterprise is an important consideration in planning a use for feed surpluses, the amount of which may vary greatly from year to year. A labor and management wage of $2,774 was estimated for this system of farming.

Increasing the amount of cropland under the cash feed system to approximately the optimum acreage is one alternative that can be followed under the Agricultural Adjustment program. Assuming that land is available, increasing the size of farm will permit farmers to make reasonably complete use of their operating capital without greatly changing their system of farming or having to learn the techniques involved in new enterprises. This system has the benefit of increased efficiency which is reflected in earnings. The estimated labor and management wage amounts to $3,217.

The size of operating units and earnings can be further increased through maximum use of mechanical methods of production. Within a period of 15 years, farmers of this area have shifted almost completely from one-row horse-drawn equipment to two- and four-row motorized equipment. Recently improved combines along with the development of varieties of grain sorghums suitable for combining have enabled farmers to complete the mechanization of sorghum grain production. A stripper type cotton harvester has been developed by the Texas Agricultural Experiment Station. A limited number of these machines were manufactured for distribution in this area in 1943. More will be available in 1944. Mechanization of cotton harvesting would eliminate the need for labor from outside the area.

Maximum mechanization under these conditions involves the use of four-row tractor-drawn equipment for pre-harvest operations and mechanical harvesting of cotton and grain sorghums. With this equipment, 540 acres would be the optimum crop acreage under the Agricultural Adjustment Administration program. The estimated labor and management wage of $6,899 is nearly double that of other alternatives.